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ELECTRICAL EXPORT TRADE.

The electrical export trade is holding up remarkably well, and the figures of last year are more than made good by those of January. It appears that the export of electrical instruments, for the month, including telegraphs and telephones, was $529,253, as compared with $387,610 last year, and that the total for the seven months was $3,519,566 as compared with $2,692,460. A gain of nearly a million in the period is decidedly encouraging. The export of electrical machinery was also excellent, being $799,939 as compared with $564,999; while for the seven months' period, it was $4,385,366 as compared with $4,032,116. The gain in this instance is only $350,000, but that is not bad in view of the large business done last year, running far ahead of 1904, when the total of machinery for the seven months was but $2,892,251.

The exports were well distributed, but it is interesting to note that Japan is taking much less than she did during the strenuous times of war in 1905, her requirements of electrical machinery from us having fallen off from $613,900 in the seven months of last year to $390,133; while in January she took only $39,046. The Philippine business also declined, over the seven months, from $152,159 to $62,934, but British Africa doubled up on $74,529, France exhibiting an even greater gain. All told, there is a cheerful indication of permanent and growing demand about these figures.

THE ART OF TELHARMONY.

In recording the history of electrical development throughout the world, this journal often enough has had occasion to describe interesting and important improvements in details of existing art. But it is not often our privilege to announce the birth of a new electrical art. Such an event we to-day bring to public attention in describing on another page the Cahill telharmonic system. It is rare indeed that a great original invention waits for technical presentation until it is ready for immediate commercial application. Such has been the desire of Dr. Thaddeus Cahill, the inventor, who has given to us a realization of one of the most fascinating among Bellamy's dreams in "Looking Backward." Beautiful music is to-day being produced in a dingy shop in Holyoke, Mass., from a group of alternating-current dynamos—directly produced from the dynamos, without intervention of tinkling cymbal or of sounding brass, or of twanging string. And the music may be heard whenever a wire can be stretched. The telephone may be said to have been delivered of its first-born, for it is through a telephone that this music is hereafter to be heard—but in tones loud enough to fill the greatest auditoriums. A new field is also opened to the composer, who may deal with the familiar qualities of sound and with others never heard before. A new field likewise is opened to the performer, who may interpret with a delicacy of control never possible heretofore on any known instrument.

Future Paderewskis sitting in New York may be heard in ten thousand places miles apart and in each place the original effect is heard. In each place music is produced not reproduced. Hence a new field is open to the inventor, able to provide the

means by which one artist or one orchestral group is multiplied into ten thousand. Happily the necessary limitations of manufacture will prevent any serious hardship to the professional musicians of to-day, in the introduction of the new system. They will have time to adjust themselves to the new conditions which, it seems, must dominate many branches of their art in the future. Nor will the manufacturers of our familiar instruments be injured at once—though they must obviously take immediate account of the Cahill telharmonium. No matter how much we may industrialize and commercialize any product, there will, of course, always be a demand for the original, individual, separate and exclusive work of an artist.

Its first appearance in New York three months hence, of this invention, will be as a central station instrument of imposing size. The business plan is that the music shall be sold first to hotels, restaurants, theatres, concert halls, department stores, and to such private persons as are able to command any novelty. It will probably not be difficult to place with such selected customers all of the four or five thousand outlets which the present machine can supply. But the invention lends itself also to the establishment of "isolated plants." It will soon be known in private use—a small instrument of piano size giving various sound qualities and played upon by the individual home musician. The metropolis of work-a-day America will thus witness the triumph of an American inventor who, if what we have set forth is true, has done more for the art of music than has been done by any other separate invention since the time of Pythagoras. That such a revolution should be worked by electricity was to be expected. It is a pleasure to us to name a new man—Cahill—and a new thing—"Telharmony"—as among the notable achievements of our modern day. Another great electrical industry has been created. Let us hope that those who control it will make moderate use of their patent privilege, leaving to the public a large part of the benefit due to an enormous decrease in the cost of one of civilization's necessities.

The Benefit of Cheap Power to a Town.

The account given elsewhere of the Janesville, Wis., central station contains much that is suggestive to those operating plants under somewhat similar local conditions. One deduction is the benefit of a day power circuit to the growth of a small town. To be sure, no central station company is going to start a day power circuit purely to benefit a town without some adequate return, but once such a service is started, the company should not fail to bring the importance of the power service prominently before the people as a factor in influencing the location of small industries in the town. This in itself has an indirect advertising value as it gets the owners of industries already in the city in the way of thinking that electric power is the proper thing. Many small factories were influenced to locate in Janesville by reason of the cheap and reliable power supply offered by the central station, which carries the greater part of its load by water power. Mr. Korst does not consider, however, that residence lighting should be given a secondary place, since this service takes current during the day and on Sundays and holidays, when the station load is low. Not a few central station men are coming to consider that the residence lighting load also is to be compared favorably with that obtained from the business districts for the reason that it continues through the evening and gives an all-around better load curve than store lighting in a town where stores close every evening promptly at six o'clock.

Rate Regulation Lessons.

In another column mention is made of the progress of the investigation of electric light rates in Chicago, and of the voluntary offer of the Chicago companies to reduce maximum rates. As in the case of the New York Telephone Company last year, the movement to regulate the rates was thus met in a spirit far different from that so often displayed by public service attorneys in handling such situations—that of standing on legal rights and fighting, incidentally to the great profit of said attorneys. The Chicago companies bowed to the claim of the moral right of the community to have a voice in fixing public service rates, and virtually waived any legal rights upon which they might have stood. Their position in offering to open their books to the investigation of the Council committee and to reduce rates not only has won warm favor from the public and the press, but naturally has constrained those dealing with it in the present proceedings to adopt a reasonable attitude. The intention of the Iowa Electrical Association to have the question of rate legislation in all its aspects discussed at sessions open to the public is another move in the right direction. The attitude of public service corporations in approaching these questions should be a willingness to bring out the facts and to co-operate in working out the best possible solution. They will by so doing fare much better in the long run than by assuming an uncompromising attitude at the start, and thereby arouse hostile sentiment.

The action of the Chicago companies in voluntarily reducing maximum rates and abolishing last year the minimum bill of $1 per month raises an interesting question in equitable rate making. There is little doubt that the short-hour users who pay the maximum rate and the small users who pay minimum bills many months in a year are unprofitable customers. Any movement to reduce maximum rates or abolish minimum bills is sure to be popular because it affects so many customers. It is equally sure to be inequitable because it makes the profitable class of customers pay the losses on the business of the small and the short-hour consumers. A company may figure that for the sake of popular approval it can do a small percentage of its business at a loss, but it is certainly contrary to all our modern theories of so adjusting rates that each consumer shall bear his true share of the whole expense.

Calculation of Dynamo Sparking Constants.

We publish, on page 525 of this number, an article on this subject by Mr. A. Press. It forms in one sense a sequel to an article by the same author on page 1027 of the preceding volume (December 16, 1905). Some of the formulas in the earlier article have undergone a considerable modification in this new article, but this change is to be welcomed if it comes from a careful comparison of a large number of dynamos in known practical operation. The theory of sparking at commutators is, in one form or another, as old as the practice of building direct-current dynamos. A number of empirical formulas have been offered by engineers, at different stages of the dynamo development. The literature of the subject is bulky to the verge of tediousness. The full theory of the seemingly simple phenomena of commutation is admittedly so complex, that it is probably hopeless to seek a formula that will deal with the matter from a strictly physical standpoint. All we can hope for, at present, is an empirical theory based upon the fundamental principles of what would support a full scientific theory, but checked by experience on a large number of actual commutators in daily use.

The empirical formulas offered by Mr. Press are apparently not difficult to apply. It would be, however, very desirable to have a table furnished which would show the actual values of the critical quantities considered in a large number of recognized machines, in such a manner that the tabulated value could be checked by each engineer from his own experience, and the results of the empirical formula compared. It is only in such a way that general confidence in a new empirical formula can speedily be secured. Our engineering formulas used in the construction of dynamo machines are mostly capable of considerable precision, and have shown themselves in practice to be reliable. Our empirical formulas relating to the sparking limitations of commutators are not in so satisfactory a condition. There is still discussion and difference of opinion over them. Consequently, it is a matter of considerable importance that any new empirical spark limit formula should be thoroughly tested and elucidated by numerous examples.

INAUGURAL ADDRESS OF THE PRESIDENT OF THE BRITISH INSTITUTE OF ELECTRICAL ENGINEERS.

The inaugural address of Mr. John Gavey to the British Institution of Electrical Engineers covers a wide field in telegraphy and telephony, subjects with which, as head of the electrical engineering department of the British Post Office, he is entirely familiar. The address contains a collection of interesting and valuable statistics. From this standpoint alone, it is one of the most noteworthy recent additions to electrical engineering literature in the telegraphic and telephonic departments. The growth of telegraphy in the United Kingdom, judged by the number of telegraph instruments installed, appears to have been fairly steady at about 6 per cent per year for the last 25 years. On the other hand, the growth of telephony in the hands of the Post Office has been at a much more rapid rate, so that at the present time the growth in line conductors is nearly all on telephonic account. Some brief world statistics or estimates are offered of the development of telegraphy and telephony in all civilized countries up to the year 1902. They indicate that there were then over 3½ millions of miles of telegraph wire, and nearly 7½ millions of miles of telephone wire in use. If we allow two miles of wire to the mile of telephone circuit, or assume metallic circuits for all telephony, this would mean that the total length of telegraph and telephone circuits in the world were about the same for the date referred to, and either would more than girdle the sun. The total number of telephone instruments connected was about 3½ millions, or nearly one per mile of circuit; while the number of telegraph instruments installed was about ¼ million, or about one to fourteen miles of telegraph circuit. At the present time, the rate of telephonic increase is far greater than the rate of telegraphic increase.

The tendency in Great Britain at the present time is in the direction of placing the telegraph trunk lines across country underground, and leaving the telephone wires overhead. A main underground cable of telegraph wires from London to Glasgow is shortly to be completed, and a speed of 200 words per minute, through one repeater, is expected. This is a distinct achievement, rendered possible only by the substitution of paper and air for gutta-percha, as an insulator. A complete trunk system of underground conductors is expensive, but it forms a valuable national asset, since it places internal telegraph communication beyond the ordinary reach of climatic disturbances. This movement towards sheltering the telegraph trunk lines in the lap of mother earth is one on which the government of Great Britain is to be congratulated, as securing an important link in international communication, so essential to the development of general civilization. Full and courteous acknowledgment is given in this broad-gauged paper to American methods in one direction and to British manufacturing enterprise in another.

COMMUTATION IN SINGLE-PHASE MOTORS.

The greatest difficulty which has been encountered in the design of alternating-current motors of the commutator type has resided in the unavoidable e.m.f. produced at the coil under the brush due to the variation in the field magnetism. To the existence of this e.m.f. can be attributed the lack of progress in the development of this type of motor previous to the last few years. Although numerous schemes have been devised for compensating for this e.m.f. when the armature is in motion, no method has as yet been proposed by which it can be neutralized when the armature is stationary, on account of the fact that both the flux which causes the e.m.f. and the coil in which the e.m.f. is generated, are necessary for the successful operation of the motor. It follows, therefore, that while many forms of this type of motor commutate satisfactorily near synchronism, or under speed conditions, all forms of alternating-current commutator motors are equally disadvantageous with reference to the e.m.f. to be short-circuited by the brush at starting.

Of the many methods which have been proposed for minimizing the effect of the short-circuited e.m.f. in the coil under commutation, those which involve the use of resistances in series with the coil seem to have been most successful. Both the short-circuit current and the main motor current must pass simultaneously through these resistances as they are ordinarily inserted in the coil circuit. As far as concerns commutation, it is desirable that the value of these resistances be as large as possible, while the loss of power due to the passage of the main motor current through them dictates that the value be kept quite small. Even on the score of efficiency alone an extremely small resistance would result in an enormous loss due solely to the short-circuit current, so that there exists a definite value which produces the best general efficiency of the motor or the most nearly perfect performance of the machine. On page 522 of the present issue is given an interesting discussion by Mr. Marius Latour of the commutation of single-phase motors as affected by the loss of power at the contact between the brush and the segments. The complete solution of the problem is quite difficult, but the author has rendered the task relatively simple by treating the commutation by three different methods, each of which is incomplete in itself, and then finding certain relations which exist between the individual results, the combination of which affords an adequate view of the complete solution. The assumption is made that the heat produced at the brush should be a minimum, and three criteria are employed, namely, the average quantity of heat produced per second and per square centimeter under the brush; the average quantity of heat produced per second and per square centimeter at the edge of the brush, and the voltage between the brush and bar at the moment when the brush leaves the bar. The author shows that with a brush of a certain width it is advantageous to cover as many commutator segments as possible, but that for practical purposes two or three segments are sufficient. Although the expressions for determining the conditions which render the heating at the brush a minimum are complicated, for any certain design of motor the major portion of the expression becomes a constant and the solution of the resultant equations is quite simple.

A. I. E. E. Election.

The Philadelphia branch of the American Institute of Electrical Engineers has mailed a postal card to all members of the Institute repudiating a circular (of which note was made in these columns following its issue), dated February 10 and sent out with a nomination ticket headed by Dr. Sheldon, which ticket purported to have the sanction of the Philadelphia members. The postal card states that no such committee as referred to in the circular was appointed and that the circular was entirely unauthorized. The circular, moreover, bore an address in Philadelphia which does not exist. This official communication, though dated February 20, is post-marked March 1, and thus did not reach members until too late to counteract the effect of the bogus circular at which it was directed.

Development of Southern Water Power.

At no time has more attention been directed to the development of Southern water power than the present, and several large schemes are being carried out. Stone & Webster, of Boston, have recently arranged for the purchase of the Columbus Power Company, the Coweta Power Company and the Chattahoochee Falls Company. The purchase of these companies, together with some additional lands known as the Standing Boy Creek properties, gives control of all water power property practicable for development on the Chattahoochee River between Columbus, Ga., and a small completed development just below West Point, situated about thirty miles above Columbus. It is estimated that 75,000 hp can be developed within a distance of 15 or 20 miles of the city of Columbus.

The properties acquired will be merged in a new company to be called the Columbus Power Company. The capitalization will include $4,000,000 of 30-year 5 per cent gold bonds, of which $1,375,000 will be sold forthwith, $1,650,000 will be certified on the execution of the mortgage, and $275,000 will be held in the treasury. The bonds are guaranteed by the Columbus Electric Company and are callable at 110 and interest. The sinking fund is to be 1 per cent per annum, of bonds issued, the first payment to be due in 1912. The preferred stock authorized is $350,000, to be fully issued, and redeemable at 103; preferred as to dividends and in case of liquidation. The common stock is $1,500,000, which will also be fully issued.

The first step in the development of this water power property will be the construction of a 3,000-hp steam plant to supplement the existing hydraulic plant of the present Columbus Power Company. This will increase the generator capacity to 11,000 hp. Additional hydraulic development will be made from time to time as may be necessary to meet the demands for power.

All of the common stock of the new company, together with a portion of the preferred, will be held by the Columbus Electric Company, a Stone & Webster property, which owns all the securities of the Gas Light Company of Columbus, and practically all the securities of the Columbus Railroad Company. These latter named sub-companies do the entire gas, electric light, electric railway and retail power business in the city of Columbus.

It is expected that the proposed development will greatly stimulate the growth of the city of Columbus and lead to the establishment of many new mills and manufacturing enterprises which are based more or less upon an abundant and steady supply of cheap power.

Limiting Public Service Corporate Stock.

Mr. H. P. Nichols, who is in charge of the bureau of franchises of the New York Board of Estimate, has inserted in a recent franchise contract with a new company a clause prohibiting the issuance by it at any time of stock or bonds, without the consent of the board. In his report on the subject he speaks of overcapitalization as one of the crying evils of the day, and says: "This is frequently a capitalization of anticipated profits, and has a direct bearing upon the cost to the consumer of the product manufactured by the company so capitalized. If a company whose capitalization or whose funded debt is many times the value of its tangible property, and especially if the company has a monopoly of the business in which it is engaged, there is a temptation to that company to charge for its product an amount far beyond what would be sufficient to pay the cost of production plus a fair return upon an amount which would represent the actual value of the plant.

"There are railroad companies in the City of New York whose capital stock outstanding and whose funded debt each are equal to many times the value of the tangible property. Probably the same may be said of other public service corporations in the city.

"The city is, in a way, a partner in the business which requires the use of public property such as that conducted by railroad companies, gas companies, telephone companies or other enterprises requiring the use of public streets. These companies are supported by the revenue obtained from their patrons, while the city is, or should be, financially reimbursed for the occupation of public property. The occupation of the streets is absolutely necessary for these companies to carry on their business. On the other hand, it is to the city's interest that citizens be supplied with the conveniences or necessities which may be furnished by such companies at reasonable rates if the right is given for the streets to be occupied for that purpose.

"The authorities are, therefore, interested in the business to such an extent and any contract entered into between the city and the company applying for rights, should be such as will protect those citizens against a possibility of unfair charges, and if overcapitalization tends to develop such charges, then the contract should be sufficiently broad in its terms to prevent overcapitalization.

"Should public service corporations receiving rights from the city fail in the future to give the people adequate service and for that or other reasons the city government deems it necessary to take control of such property, it will be impossible to do so by a payment of a fair value of the property if such company is overcapitalized without, perhaps, doing an injury to innocent investors in stocks or bonds, which have been issued in excess of the value of the property."

The Iowa Electrical Association Programme.

President Austin Burt and other officers of the Iowa Electrical Association have prepared a programme for the next Iowa Electrical Association convention that appears to fully sustain the reputation of that association for getting up papers and discussions of great practical value to the central station men of that State. The convention will occupy two days, April 18 and 19, with the probability of an evening session on the first day. The second day will be largely given up to a thorough discussion of the rate legislation question, to which the public will be invited. The idea is to have as complete an airing of the subject as possible that public sentiment in the matter of rate regulation be guided in rational channels.

The programme for the meeting as announced by Secretary George S. Carson, of Iowa City, is as follows: Address of welcome. President's address. Reports of secretary, treasurer, Executive Committee and Finance Committee. Report on progress, by J. R. Cravath, of Chicago, western editor of the Electrical World. Report of Committee of Facts and Factors, by D. F. McGee, Red Oak. "Central Station Publicity," by Frank B. Rae, Jr., of the C. W. Lee Company, Newark, N. J. "Economy of Mechanical Stokers and Ash Machinery in Small Stations," by C. F. Freehauf, of Cresco. "Economy of Condensing Plants in Small Stations," by W. A. Mall, of Belle Plain. "Effect of Boiler Compounds on Engine Lubrication," by L. W. Gill, of Manchester. "Line Losses and Economical Distributions," by J. A. Innes, of Eagle Grove. "Care and Maintenance of Meters," by A. W. Zahm, of Mason City, and H. G. Gorr, of Dubuque. "Some Practical Experience with Steam Turbines," by C. E. Stanton, of Dubuque, and Niels Christensen, of Waterloo. "Experiences with Grounded Secondaries," by H. G. Gorr, of

Dubuque; Thomas Sloss, of Cedar Rapids, and W. P. Cosper, of the Garton-Daniels Company. "Effect of Day Load on Station Economy," by J. P. Jones, of Cedar Falls; T. H. Richardson, of Boone; W. J. Greene, of Cedar Rapids, and J. Walsh, of Davenport. "Ways and Means of Increasing Business in Towns under 5,000," by W. S. Mead, of Parkersburg; O. E. Brownell, of Lake City; Joseph Hutchinson, of Manchester, and Thomas Ferris, of Osage.

The discussion pertaining to rate legislation includes the following: "Depreciation of Electric Properties," by Prof. G. W. Bissell, of Iowa State College, Ames. "Unreasonable and Unrestrained Rate Agitation," by L. Y. Sherman, Lieut.-Governor of Illinois. "Equitable Rates," by George McLean, of Dubuque. "Legal Status of Rate Regulation," by Mr. Hurd, of Dubuque. "Political Status of Rate Regulation," by Hon. M. J. Wade, of Iowa City.

Convention headquarters will be at the Kirkwood Hotel. Supply houses are invited to make exhibits and have representatives in attendance. The Iowa Street & Interurban Railway Association will hold its convention April 19 and 20, thus synchronizing with the other society.

The German Submarine Cable Network.

A very interesting review is presented by U. S. Consul Liefield, of Freiburg, Germany, on the development of the German submarine cable system. He calls attention to the significant fact that the new cable from Yap, in the Caroline group, to Shanghai, furnishes the final link in the first non-British cable to encircle the globe. He gives also the following data:

The year 1905 has been for the German cable industry a very significant one, for it not only gave to Germany a great many new cables, but the advantages and advancements made in sea cable technic can be said to have been in every respect first-class. It is claimed that the rapidity and precision with which the newest German cable from Shanghai to Yap, in the Caroline Islands, was laid, which had been finished and ready for use on November 1, are unexcelled.

The number of German cables which have a length of over 62 miles has been increased through this new cable to thirteen and are as follows: Emden-Borkum-Lowestoft (England) (1871), 261.5 miles; Hoyer-Westerland-Arendal (Norway) (1879), 293.3; Emden-Valentia (Ireland) (1882), 984.8; Emden-Borkum-Vigo (Spain) (1894-96), 1,304.2; Sassnitz-Trelleborg (Sweden) (1898), 72.7; Emden-Borkum-Horta (Azores) New York (1900), 4,790.1; Tjintau-Tschifu (China) (1900), 283.9; Tsintau-Shanghai (China) (1900), 436.2; Emden-Borkum-Bacton (England) (1901), 288.9; Emden-Borkum-Horta (Azores) New York (1903), 4,911.9; Konstanza (Roumania) Constantinople (1905), 213.1; Menado (Celebes) Yap (Caroline) Guam (Ladrones) (1905), 2,018.8; Shanghai-Yap (Caroline) (1905), 2,229.4.

Of these the Emden-Valentia and Emden-Borkum-Horta belong in common to Germany and England; Sassnitz-Trelleborg in common to Germany and Sweden, Emden-Borkum-Vigo and Emden-Borkum-Horta to the German Atlantic Company; Koustanza, to the East European Company; Menado-Yap and Shanghai-Yap to the German-Netherlands Company, and only the remainder can be considered as the sole property of the German Empire. The Emden-Valentia was formerly the only telegraphic communication with America, but ceased to be used when the real German Atlantic cables, Emden-Borkum-Horta and Tjintau-Tschifu, were completed. Besides these large ocean cables there are a great number of shorter ones which are partly in use between the various German seaports, and between Germany and neighboring countries. For example, there is a cable 51.57 miles long from Arkona to Trelleborg, Sweden, which has been in use since 1865, and besides these there are three African cables which have been rented from the owners, the different English cable companies. These are as follows: East Africa, Sansibar-Bagamoya-Dar-es-Salaam, 84.5 miles; Southwest Africa, Swakopmund-Mossamedes, 152.8 miles; Kameron, Boony-Duala of 209.4 miles. Of these, the first two belong to the Eastern and South African Telegraph Company, and the last to the African Direct Telegraph Company.

Altogether Germany has over 18,816 miles of cables, of which, however, only about 3,293 miles are owned by the Government. The total cable length of the earth is between 273,402 and 279,616 miles, from which will be seen that Germany's percentage is, notwithstanding all the progress which had been made in the last year in that direction, very modest. Really, only about one-fifteenth of the total cable length is German, while England has more than two-thirds. Not more than two years ago, however, Germany's part was no more than one-twentieth, so it is evident that since that time Germany has made great strides forward.

From Europe to east Asia and to the Chinese coast there are the land telegraphs and sea cables of the Danish Great Norse Telegraph Company. The Atlantic Ocean is traversed not only by the English telegraph lines but also by the American, French, and German cables. These are, through the various service lines of the United States, combined with the western coast of America, and from San Francisco the American Pacific cable extends via Guam to the Philippines. In Guam, however, the German-Netherlands cable system branches off to Yap, from which place the new cable has made a new bond of union with the German and Danish lines on the Chinese coast. The cable Shanghai-Yap assures to Germany henceforth a telegraphic union with the Ladrone and Caroline islands independent of English influence, and these islands are German colonial possessions, besides also the union with the Great Sunda Islands and the important Dutch colonial possessions in Farther India, which are so important also for the German commerce.

The Shanghai-Yap cable line has been laid in greater sea depths than any other cable. Up to a few years ago there was no cable in a greater ocean depth than 16,404 ft. The American cable in the Pacific Ocean was in 1903 laid in depths to 20,469 ft. The cable Menado-Yap-Guam, which was laid in the year 1905 by the German cable steamer *Stephan*, surpassed this record, inasmuch as it was obliged to lay the cable in depths of 22,966 ft., and to lay the cable Shanghai-Yap, which work was also the task of the cable steamer *Stephan*, it was even necessary in the vicinity of Liukiu Islands to reach depths of 26,246.96 ft., which is one of the deepest places to be found anywhere in the oceans. The cable was manufactured in Germany by the North German Sea-Cable Works in Nordenham at the mouth of the Weser.

Discussion on the Single-Phase Motor in Central Station Work.

A meeting of the Chicago branch of the American Institute of Electrical Engineers was held February 27, at which Mr. W. A. Layman, general manager of the Wagner Electric Manufacturing Company, of St. Louis, read a paper on the "Present Status of the Single-phase Motor in Central Station Work." Mr. Layman classified commercial single-phase motors under three general heads: The commutator type, the synchronous motor and the modified polyphase induction motor. He then reviewed the principal patents having a bearing on the motors made by the Wagner Electric Manufacturing Company to-day. The first patent mentioned was issued to W. A. Anthony, D. C. Jackson and H. J. Ryan, September 11, 1888. It shows a commutator type repulsion motor in which the field coils of the motor are connected to the single-phase supply line and the armature circuit is closed through a resistance connected between the brushes. The next patents mentioned were granted to Prof. Elihu Thomson in 1889 and 1890. In these were shown an armature open-circuited at the start and short-circuited like an induction motor when up to speed. This type was stated to have never proved successful in practice. It remained, the author said, for Prof. E. Arnold, a German engineer, to make the final practical combination which is used in the Wagner constant-speed motors of to-day.

The Arnold patents referred to as covering the present Wag-

ner construction were issued August 6, 1895, and June 23, 1896. They show a motor started as a repulsion motor with short-circuited brushes bearing on a commutator. After the motor is up to speed the brushes are lifted off the commutator and the armature winding is short-circuited automatically. He mentioned also a patent issued to Ludwig Gutmann in 1894 showing a motor having its fields excited by a single-phase alternating current and a ring armature cross-connected at various points. He then briefly referred to the split-phase motor patents of Tesla. He spoke briefly of the contest waged in the early nineties between the General Electric, Ft. Wayne and Wagner companies over a single-phase motor which operated practically like a self-excited rotary converter started from the alternating-current end. This type of motor was abandoned on account of the excessive voltage disturbance it created on single-phase lighting feeders while being started. He then gave circuits of the elevator motor now being made by the Wagner company, which is the design of Leo Schueler, a German engineer.

This motor was designed for frequent stopping and starting in elevator or crane service without excessive line disturbance. The field coils of this motor are star connected, only two legs of the circuits being in use at once. A two-point switch (by means of which either one of two legs of the star connected field coils may be joined to the supply line) is used for reversing the motor. The motor armature is provided with a commutator upon which brushes bear during starting. Between these brushes is a resistance which is permanently adjusted at the time the motor is installed. The motor also has collector rings through which current is taken off at three points from the armature windings. Between the collector ring brushes, are placed resistances which are varied by the lever of the elevator controller. This motor when operated as a purely repulsion motor would give about 60 per cent of its full-load capacity; hence the advantage of operating it as an induction motor when up to speed. He said the manufacturers of this new motor had made no great effort to introduce it during the 18 months it had been on the market, but had placed a number on trial in different parts of the country to determine its performance, which has been all that was expected. He also referred to the fact that series commutator types of single-phase motors are being developed by both the General Electric and the Westinghouse companies for railway work, and also for the operation of elevators and cranes from single-phase, 60-cycle central station circuits.

In response to a question from Chairman Miller as to the present commercial status of the split-phase motors in which condensers are used to give a rotating field with single-phase supply, Mr. Layman said that the size of condenser needed was so great that the cost was excessive, being about 50 per cent of the price of the motor. His company at one time attempted to use condensers in parallel with its single-phase induction motors in order to compensate for the lagging current and bring the power factor of the equipment to unity. Condensers were found to be more trouble and expense than they were worth.

Mr. J. R. Cravath said that the single-phase motor situation was at present one of great interest to a large class of small central station men who were considering enlarging their motor business and who already had single-phase lighting distribution systems. It is also of considerable interest to companies operating polyphase distribution systems, because with single-phase motors as now developed it is not necessary to extend polyphase distribution into single-phase territory to handle motor load except where large motors are needed. The development of single-phase motors for elevator and crane work will put a central station in a position to use single-phase circuits for any class of work done by direct-current motors with the exception that had been noted by Mr. Layman, namely, the operation of variable-speed motors at different constant speeds, as in machine-tool driving. He asked for an expression of opinion as to whether it was advisable for a small company operating a single-phase lighting and power system when enlarging its plant to purchase three-phase generators with a view to the use of three-phase motors for larger motor work, or whether it would be better to adhere to a strictly single-phase system throughout.

Mr. H. B. Gear spoke very favorably of the performance of the Wagner motor on the Commonwealth Electric Company's lines in Chicago. This company has polyphase distribution with single-phase branches. All motors of 5 hp and under are single-phase Wagner machines, as the company cannot afford to run three-phase circuits and install the necessary transformers for three-phase motors of less than 5 hp. He thought, perhaps, Mr. Layman had not emphasized sufficiently one good feature of the Wagner motor, which was that it will automatically and safely start itself after any momentary interruption of the circuit. This is not true of either direct-current or polyphase motors. He thought, perhaps, the Schueler elevator motor described by Mr. Layman would be found to disturb the voltage on the majority of single-phase lighting circuits too much. The disturbances caused by starting constantly running motors on a single-phase lighting circuit come only at infrequent intervals and those often in the day time.

A 10-hp Wagner motor used for elevator work, however, must be on a large feeder close to the station if it is not to disturb the lighting service, as it is started many times a day, and its use continues through the evening when good voltage regulation is most essential for the lighting service. The dividing line between three-phase and single-phase motors in Chicago in the past had been placed at 5 hp, mainly on account of the objection of the customers to the extra price charged for the single-phase motor as compared to the three-phase. When the motor was as small as 5 hp, the company had to draw the line because of the transformer and line expenses. As a matter of fact it would be cheaper for the company to insist on the single-phase motors as high as 10 or 15 hp. In answer to Mr. Cravath's question as to the use of single-phase or three-phase generators in enlarging a small single-phase plant, he thought that if a company contemplated operating motors as high as 50 hp with a plant capacity of, say, 300 or 400 kw, the generating station should be three-phase. The starting current of large motors would then be divided between three phases so that the disturbance of lines would be less. In small plants where the largest motors would be of 15 hp, it might be better to adhere to the single-phase system entirely.

Mr. Layman, taking up this same question, advocated the use of three-phase generators, even though much of the distribution was single-phase. The three-phase generator can be purchased at about 25 per cent less per total kw of capacity, so that it is about as cheap as a straight single-phase generator even if only one phase is loaded, while there is always the opportunity of operating polyphase distribution from it. He thought the four-wire, three-phase system used by the Commonwealth Electric Company in Chicago to be the best one yet worked out for large companies. At Newark, N. J., three-phase generators are used, although the distribution is almost entirely single-phase. In answer to a question as to why larger single-phase motors are not built, Mr. Layman replied that the principal reason is that there has not been sufficient demand for them. He pointed out the fact that it is not safe for a central-station company to offer its customers a choice of several kinds of motor, because the customer will always choose the cheapest motor without regard to its bearing on the central station's distribution system. It is best for the central station company to adopt a definite policy as to the kind of motor to which it will connect, and adhere to it.

The Manila Telephone Plant.

Shipments of copper wire and cable were recently made from San Francisco to Manila, for the completion of the new telephone system now being established by the Philippine Telephone & Telegraph Company. The switchboards have been shipped and they will be installed by American electricians who have gone to Manila for that purpose. It is expected that the Manila system will be in complete operation by July 1. The company expects to extend its service from Manila to the densely populated districts of the islands.

CURRENT NEWS AND NOTES.

WEST VIRGINIA INDEPENDENT TELEPHONE INTERESTS.—One hundred managers and directors of independent telephone lines in West Virginia met February 22 and 23 in Parkersburg, W. Va., for the annual convention of the West Virginia Independent Telephone Association. J. W. Hoge, of Cleveland, made an address on "The Future of Independent Telephony."

MEN OF SCIENCE.—A very interesting quarto volume, "Men of Science," edited by Prof. J. McK. Cattell, of Columbia University, New York, has just been issued by the *Science Press,* of Garrison, N. Y. It is a biographical directory of American men of science, and in addition to giving the main facts in their technical or scientific career, gives a note as to the particular branch of study, investigation or original research in which they are interested. In many respects it is an extremely useful publication.

WARREN & JAMESTOWN SINGLE-PHASE RAILWAY.—In the description in our issue of February 17, of the Warren & Jamestown single-phase railway, the Warren terminal of the line was erroneously located in Ohio, instead of Pennsylvania. The lines run from Warren, Pa., in the oil and natural gas district, to Jamestown, N. Y., on the shore of Lake Chautauqua, and passes through Ackley, Russel and Glade, Pa., and Falconer, Frewsburg and Fentonville, N. Y. Stops are made at 53 stations along the line, the length of which is 22½ miles.

ELECTRICITY IN INDIA.—Reports from Bangalore, the "Jungle City," state that electrical transmission of power is being carried out on a large scale. The city is well lighted by electricity, current for which is supplied from the plant located on the Cauvery River, 40 miles distant. The same plant furnishes the motive power for the mills of the Kolar gold field, which has paid $5,000,000 in royalties to the State and $50,000,000 in dividends to the share holders. The Cauvery enterprise is characteristic of the spirit which is making Mysore the model state in India.

URANIUM ORE.—U. S. Consul Ledoux reports from Prague that uranium ore can now be secured from the Austrian government mines of Joachimsthal, Bohemia. For post parcels the cost is $3.32 per pound; in larger shipments, according to the assay, 50 per cent ore at $2.22, and 60 per cent ore at $2.66 per pound. The Austrian authorities inform Mr. Ledoux that the residue, pitchblende, is not available for sale. Consul Ledoux also advises that the historical Wolfram tin ore mines in northern Bohemia have been reopened by the Schönfeld-Schlaggenwalder-Wolfram-Zinnersgruben Gewerschaft.

NEW ORLEANS-ST. LOUIS WIRELESS.—On February 28 the new high-power long-distance wireless telegraph station at New Orleans was put in operation by President Abraham White, of the American DeForest Wireless Telegraph Company. Since that time messages have been exchanged between New Orleans and St. Louis nightly. As a matter of fact, the New Orleans station was erected for the purpose of communicating with ships in the Gulf of Mexico, and with stations on the Gulf, at Mobile, Southwest Pass, Galveston, Pensacola and Key West. At night time the station can also communicate with Havana, St. Louis and other inland points that have high-powered equipments.

GROWTH OF N. E. L. A.—Mr. W. C. L. Eglin, secretary of the National Electric Light Association, states that the interest in the convention at Atlantic City is unprecedented, for so early a date. A number of manufacturing companies have applied for membership in the Association for the express purpose of securing exhibition space, and many others have expressed their wish or intention to do so. The growth in the active and associate classes has also been notable, including some thirty central station companies, and two score individual members. Preparations of the most extensive character for the June convention are being made.

POWER DEVELOPMENT IN COLORADO.—According to reports, the engineers who have been employed to consider the latest Colorado power proposition have completed their work and their report is now in the hands of the New York capitalists who are promoting the project. The report, it is said, is favorable, and plans are under discussion for the organization of a company to build an electric power plant at Lafayette, Col., with an initial capacity of 10,000 hp. From this point the system would be extended to Cheyenne, Wyo., and possibly to Fort Russell, and in the other direction to the gold mines in the vicinity of Boulder and the Gilpin County mines and mills. The proposed system will cover an area in northern Colorado about 160 square miles in extent.

CONTROL OF RATES FOR PUBLIC SERVICE.—The Los Angeles, Cal., City Council, acting under the new public service law, has begun the work of regulating the charges for service to the public by the several corporations of the city operating public utilities. The maximum rate for gas to be charged in the city was fixed at 85 cents a thousand cubic feet. Eleven cents per kw-hour for electric light and 10 cents per kw-hour for electrical power was fixed as the maximum charge for that service. All of these rates are practically the same as those now being charged by the corporations operating these franchises, and there will probably be no contest in the matter. In the matter of regulating the charges of the two telephone companies doing business in the city, a committee was appointed to consider the subject. The two telephone companies maintain a different schedule of prices, and it is expected that opposition will be encountered in the fixing of their rates. All fixed rates will take effect July 1.

GAS IN GREAT BRITAIN.—Vice Consul-General Westacott, of London, sends interesting information on the gas business in Great Britain, as shown by the Gas World Year Book, just published. There are 1,252 gas plants in England, 259 in Scotland, 110 in Ireland, 135 in Australasia, 52 in Canada, 15 in other British possessions, and 15 British gas companies operating on the Continent and other parts of the world. All large Scottish towns own their gas works, which produce 83.8 per cent. of the total, while in England only 31.3 per cent is so made and in Ireland 44.9 per cent. The largest gas company, the London Gas Light & Coke Company, makes 22,000,000,000 cu. ft. of gas per year and charges 59 cents per 1,000, while some of the other 11 London companies charge a good deal less, notably the South Metropolitan Company, which charges 48 cents, and the Wandsworth Company, whose charge is 52 cents. Gas cooking stoves grow in favor, the number having increased 250,000 last year in the United Kingdom.

RATE QUESTION IN CHICAGO.—The result of the last meeting of the gas and electric light committee of the Chicago City Council with the representatives of the Commonwealth Electric Company and the Chicago Edison Company was an offer on the part of the companies to reduce their maximum rates from 16 cents per kw-hour to 14 cents per kw-hour during the next two years and to 12 cents per kw-hour for the three years following that. The companies have at all times shown a disposition to meet the city half way in the question of establishing equitable rates. They have offered to show their books to the committee or its representatives and have taken the position that the city has the right to regulate the maximum rate that shall be charged, but that it cannot go farther than that and require the same rate per kw-hour for all classes of service. City Electrician William Carroll and Bion J. Arnold, as consulting engineer, are to make a report later on the cost of supplying electric service at various points in the city.

A PROTEST AGAINST ACETYLENE.—A delegation of citizens from Grand Crossing, a suburban district of Chicago, headed by Alderman Hunt, appeared before a council committee in Chicago recently to protest against the establishment of an acetylene gas plant there, and asked that no ordinance be passed which would permit of the storage or manufacture of the dangerous material in the city.

TROLLEY FUNERAL CORTÈGE.—Rev. Martin Van de Laar, a priest of South Chicago, Ill., was buried at that place a few days ago, the body being conducted to the cemetery on a trolley car, which was followed by 20 other cars full of mourners. Nearly 2,000 parishioners paid 5 cents each to ride on the trolley conveyances to give final honors by their presence to the departed humanitarian, and thereby they fulfilled his last expressed wish, as set forth in the will, that the obsequies over his body should be as simple as possible and should reduce expense on the part of the mourners to as small an amount as conditions would allow.

TELEPHONY IN JAPAN.—In his interesting articles on Japan, now being published by the Sunday edition of the New York *Sun*, the Hon. W. J. Bryan touches upon government ownership of public utilities in that country and incidentally upon the telegraph and telephone service. "Japan," he says, "has a telegraph system and a telephone system operated by the national Government. Telegrams are sent at the same rates to all parts of the empire, and the service is satisfactory. The telephone service is not so good, for, while it is all right as far as it goes, the system is not extended as rapidly as the demand requires. In Tokio, for instance, those who want to install telephones have to wait until some one discontinues his telephone or is willing to sell it, and a bonus is often demanded. If the local telephones were owned by the city and only the interurban lines managed by the Imperial Government, the service would respond more quickly to the needs of the community."

"SKIN-DEEP MEASURES."—Mr. J. M. Patterson, Commissioner of Public Works under Mayor Dunne, of Chicago, has resigned because he says that, as a socialist, he cannot approve the present "skin-deep measures" of municipal ownership. He says: "It was through a common belief in the cause of municipal ownership of municipal utilities that I first became acquainted with you, and in this letter of resignation I desire to express publicly just how my views on this subject have changed. They have not diminished. They have enlarged. I used to believe that many of the ills under which the nation suffers, and by which it is threatened, would be prevented or avoided by the general inauguration of public ownership of public utilities. But my experience in the Department of Public Works has convinced me that this policy would not be even one-fourth of the way sufficient." In Great Britain, he declares, where municipal trading has been highly and successfully developed, the problem of the unemployed is becoming of tremendous and sad intensity. In Germany, where government ownership of railroads has been inaugurated and municipal ownership of public utilities is paramount, the poor are growing poorer and the rich richer, with an acceleration hardly less than that "so evident in the United States."

INDIANA INDEPENDENT TELEPHONE.—At the second quarterly meeting of the Indiana Independent Telephone Association for the First District, held in Elkhart on February 27, the greater part of the session was given up to a discussion of a plan to restrain all independent companies from maintaining traffic arrangements with the Bell Telephone Company. It was maintained that there could be no middle ground or compromise between the two companies; that every telephone belongs to either one or the other; and it was suggested that any independent telephone company connecting with the Bell system should be treated as a Bell company and cut off from all connection with the Independent system. There was no one present to defend the action of a few small companies in this district, charged with maintaining traffic relations with the Bell company, and the following resolution was unanimously adopted: "That any telephone company in this district, having either direct or indirect traffic relations with the Central Union (Bell) Telephone Company, be cut off from all traffic relations with the Independent telephone companies of this district, providing such company refuses to sever its connection with the Bell company after receiving due notice to do so from the president and secretary of the district association."

FEATHER RIVER POWER.—Many years ago, as some of our readers will remember, the earliest Sprague power motors were employed in pumping operations on the Feather River, California, in order to get at gold in the river bed. The river is again to be attacked to deliver 300,000 hp over circuits 180 miles long, in the Sacramento Valley. It is the plan to construct a reservoir covering approximately 9,000 acres at the Big Meadows near the head waters of the Feather River. This reservoir will receive the drainage of over 600 square miles. From the reservoir the water will be conducted through a tunnel a mile and a half long into an adjoining valley, which will be converted into a smaller reservoir, from the outlet of which will be a drop of 2,000 ft., to the power house. After being used at this point the water will be again taken from the river a number of miles below at the famous Big Bend Tunnel, built over 20 years ago by Dr. R. V. Pierce, of Buffalo, and associates at an expense of $1,250,000, and here a second electric development will be made. This tunnel is 12,000 ft. long, 16 ft. high and 15 ft. wide at a point known as the Big Bend, where the Feather River, after running 13 miles around a mountain and falling 600 ft., goes back to within 12,000 ft. of the upper bed on the other side of the mountain. The purpose of the tunnel, as noted above, was to drain the 13 miles of river bed in order to extract the gold in the gravel, but after diverting the waters of the river its bed was found to be formed of boulders so huge that little progress could be made with the mining work, and the tunnel was abandoned. The work done at that time was illustrated in these pages.

ENGLISH TRAIN LIGHTING.—Note is made of the Leitner-Lucas system of train lighting in England, reference to which has already been made in these pages. The system has recently had a trial on the Great Western Railroad, and the officials appear to be impressed with the advantages. In the trial "the dynamos were sealed up entirely—that is, oil wells, brush and reversing gear. The automatic cut-outs were similarly placed under seal, as well as the storage battery, the sealing being done by the railway company in such a way that no replacements or repairs could be made, no oil added to the oil wells or any part of the machinery, and no water or acid added to the batteries. Mr. Leitner's claim was that he would, under those conditions, light the carriages designated during the time they would cover a distance exceeding the circumference of the earth at the equator, and during the most exacting period of the year, from October to the end of December. Any failure of light, however temporary, would have to be recorded, and the slightest repair, replacement or addition of oil, etc., would necessitate the breaking of the seals, which would either terminate the test or, in any case, be recorded. On Monday night, January 1, the distance had been exceeded, the two coaches used for the test, on arriving at Paddington from Cornwall, having covered 25,200 miles. The lights had not failed on any occasion, the illuminant being as bright on the last journey as on the first. During the twelve weeks in which the test has been operating the train has moved at varying speeds in either direction, reversing several hundreds of times; it has kept the battery of accumulators automatically charged, discontinuing when sufficiently charged. The lamps have been kept supplied with an electric current at a practically constant voltage, running or standing. The seals were taken off in the presence of a number of officials of the railway company, and several electrical engineers. It was found that though the dynamo had not had a drop of oil, nor the accumulators a drop of water or acid, they were in first-rate condition, and could have gone on for another month or more still under seal and supplied a good and sufficient light."

TELEPHONE TOLLS.—A bill providing for uniform telephone tolls of 5 cents a message at all pay stations in cities of 500,000 population in New York State, has been reported on favorably to the Assembly by its General Laws Committee.

TORONTO BRANCH, A. I. E. E., will hold a meeting on March 9, when it will consider the paper on "Self-Exciting Alternators," abstracted by Prof. Rosebrugh, and on March 23, when it will consider the subject of "Suburban Railways," presented by Mr. C. H. Wright.

TELEGRAPHONES FOR THE BLIND.—Dr. George M. Gould, of Philadelphia, proposes that the telegraphone shall be used for the better instruction of the blind, to the exclusion of Braille and all other forms of raised letters. Dr. Gould is a leading ophthalmologist. In a paper written for scientific study he discusses the telegraphone and pronounces it ideal for the instruction of those who can hear but cannot see.

CLEVELAND TROLLEYS.—Mayor Johnson, of Cleveland, is still agitating the subject of the sale to the city of the local trolleys and has recently expressed the opinion that if the city should buy the property at a capitalization of $12,000,000 it would pay for itself in eighteen years. The president of the Cleveland Railway Company holds that this is altogether erroneous. Mayor Johnson, on behalf of the city, has offered to lease the company's lines. No answer has been given to the offer.

POST STAMPING LETTERS.—United States Consul-General Guenther, of Frankfort, sends an item from German papers that a new stamping machine for letters has just been tested at the Berlin post office. The machine has been constructed by the Norwegian mechanic Krag. It is operated by electricity and works so fast that it is said to stamp 1,800 letters per minute, which would make 108,000 letters per hour. Similar machines of American design have long been in use in the United States.

NEW YORK CITY LIGHTING.—Note was made recently of the lower schedule of prices offered by the lighting companies in Greater New York for city lights. Mr. C. L. Lacombe, chief engineer of light and power in the Department of Water, Gas and Electricity, has made an analysis of the figures and shows that in spite of a large increase in the number of lamps the city bill for the illumination of streets, parks, public buildings, etc., will be less by $779,797. The total amount for 1906 under the new schedules is $2,954,236.

NEW SWISS SEARCHLIGHT.—United States Consul Keene reports from Geneva on a new searchlight recently tested at Caux, designed by E. Cuenod, showing objects clearly at 6½ miles, with diameter of projector 3.28 ft. "The great advantage of this searchlight is that it may be electrically handled in all directions by wire from a distance of 656 ft. from the motor car, which transports it and sends it to the required spot. It thus enables the driver and observer to send the rays to any place they desire without being blinded by the light, and places them under shelter from the enemy's fire. The new searchlight has already been submitted to certain high French officers, and will shortly be examined by the German general staff."

FRANKLIN IN FRANCE.—Ambassador McCormick and Premier Rouvier are planning a notable Franco-American celebration on the occasion of the unveiling of the statue of Benjamin Franklin on April 20 in Paris. Ex-Postmaster-General Charles Emory Smith, of Philadelphia, will be the chief speaker, and it is probable that ex-President Cleveland and ex-President Loubet will be asked respectively to head the American and French honorary committees. The statue of Benjamin Franklin referred to is a duplicate of that which stands in front of the Philadelphia Post Office. This replica will stand close to the site of the home occupied in Paris by Franklin. It is the gift of John H. Harjes, the American banker of Paris, to the municipality of that city. It is of bronze. The sculptor of the original is Mr. John J. Boyle, of New York.

IN THE BRITISH NAVY.—The First Lord of the Admiralty in connection with the estimates presented last week, stated that the question of firing guns by dynamo power had been definitely settled, and that wireless telegraphy had been extended in the navy.

PHILADELPHIA WATER.—Note was made last week of the complaints as to the bad condition of the New York municipal water supply and the accusation of $10,000,000 graft in it by the New York *World.* A telegram from Philadelphia as to the city supply there says: "The city is suffering as it never did before because of the intolerable water conditions. There are 2,300 cases of typhoid fever under treatment, all due, it is believed, to the fact that the great majority of the wards are supplied with water by pumpage from the Delaware and Schuylkill Rivers. To-day the water is simply filthy—so black and full of coal dust that the taking of a bath is out of the question. The mild weather has thawed the ground at the mines and dust has poured into the river, ultimately to be served to Philadelphia in the water used for drinking, cooking and the bathtub."

SERVICE TO THE PUBLIC.—Discussing the subject of large fortunes in the *Independent,* Mr. Thomas F. Ryan, who is so largely interested financially in enterprises based on franchises, says: "Fortunes which sometimes look excessive may be the result of rendering great services to the community. If a man by intense mental application or natural aptitude can introduce economies into railroad management, he is worthy of a large salary. The salary would not in any case absorb the entire saving made to the stockholders of the railroad and to the public by the reforms introduced. In some cases this claim of the inventor is compensated by the royalties paid under the patent law; and there are many services rendered in the matter of organization which are not patentable, but afford as striking benefits as patents. Take away the opportunity for winning either money or distinction by rendering such services, and few men, as human nature is constituted, would render them. It is right that competition between men should be brought within constantly narrower and narrower rules of justice. This is possible without taking away the initiative which makes men do things, and seems to me the direction in which, in spite of obstacles, humanity is tending."

TROLLEYS IN BROOKLYN.—The demands made upon capital for the development and improvement of lighting and trolley systems already in existence are not realized until a clear statement is made in regard to the subject. Thus Mr. E. W. Winter, president of the Brooklyn Rapid Transit Company, in an open letter to Borough President Coler, takes the opportunity to show how large and persistent have been the expenditures on the much-abused Brooklyn trolley system, and says: "It will perhaps be accepted even by you as some evidence of the sincerity of our purpose to improve transit conditions in Brooklyn that there has been expended to that end, within the three years last past, upward of $19,000,000, besides a much larger amount than ever before in the same period for maintenance and repairs, and that new work of construction and improvement, amounting to more than $8,000,000, is authorized for the present calendar year. The credit which has enabled this company to procure this very considerable sum of money has not been built up and sustained by decrying the conditions and institutions of Brooklyn. Much has been truthfully spoken against transit facilities in Brooklyn, and much has been said that truth could not justify. The evil effect of a habit of mischievous exaggeration which has befallen some of us when discussing this subject is reflected more or less on every legitimate business interest in the borough, while serving also to enhance the financial and physical difficulties inherent to the transit situation. Whether or not the Brooklyn Rapid Transit Company will be able steadily to proceed with the work which it has undertaken depends on the continuance of that confidence on the part of investors—not speculators—which it has succeeded in creating, and the measure of co-operation given it by the city government and the Brooklyn public, which, for its own interest, this company desires efficiently to serve."

STATE MILITARY ENGINEERING DEPARTMENT.—Under authority of an act passed by the last Legislature, a section of engineers is being recruited by the Indiana Military Department to represent civil, mechanical and electrical engineering.

VIRGINIA ELECTRIC LIGHT REGULATION.—A bill has been presented in the Virginia Legislature by Delegate Barrett, of Newport News, Va., empowering the Corporation Commission of Virginia to regulate the rates charged by water, gas and electric light companies throughout the State.

NEW YORK STATE STREET RAILWAY ASSOCIATION.—A special meeting of the Street Railway Association of the State of New York has been called to meet at Elmira, N. Y., March 29. The conference will be devoted to the reading of papers and discussion on topics pertaining to operation and management. These quarterly meetings are to be a regular feature of the association's work.

WATER PURIFICATION EXPERIMENTS.—Experiments are to be carried on under the direction of Prof. George D. Shepardson, of the University of Minnesota, at the Minneapolis City Water Works to determine the feasibility of treating the city water electrically. Prof. Shepardson says that some preliminary tests indicate that a comparatively small amount of electrical energy properly applied will kill most of the bacteria in the water.

NEWS BY TELEPHONE.—Gathering the news of central Iowa by telephone instead of by mail and telegraph is an innovation proposed by one of the large independent telephone companies of that part of the State. The plan includes the employment of a news gatherer at each point touched by the line, the duty of this employe being to gather and transmit to central points the news suitable for the daily papers of the State.

ONTARIO MUNICIPAL POWER COMMISSION REPORT.—The Ontario Municipal Power Commission will submit a plan for municipal electrical development enterprise, and if the recommendations are acted on promptly by the municipalities the work of construction will be commenced in the spring of 1907, and by the early part of 1910 electricity may be distributed throughout the various municipalities which become co-partners in the enterprise.

AN UNUSUAL MUNICIPAL OWNERSHIP PROPOSITION.—The City Council of Marion, Ind., is considering a proposition from the Diesel Engine Company, of Indianapolis, whereby the latter agrees to place machinery in the Marion city light plant and to furnish street lights for the city on a basis of 300 lamps at $55 a lamp a year, or 350 lamps at $47.50 a year each, the city to receive all income from the commercial lighting, and at the expiration of ten years the plant, valued at $100,000, to become the property of the city.

TAYLOR'S FALLS-MINNEAPOLIS TRANSMISSION.—Mr. Lee H. Parker, electrical engineer with Stone & Webster, lectured before the engineering students at the University of Minnesota on February 23 upon the development of water power at Taylor's Falls and its transmission to Minneapolis by the Columbia Improvement Company. The lecture was profusely illustrated with lantern slides showing views of the work at the water power in various stages of progress, plan and sections of power house, electric circuits, sub-stations, etc. The first installation of electric equipment will include four 3,000-kw, revolving-field, three-phase generators with transformers stepping from 2,300 to 50,000 volts at which pressure power will be carried 41 miles over a three-phase line consisting of 0000 copper, 19-strand cable on a 6-ft. center. At the outskirts of Minneapolis step-down transformers will reduce the pressure from 45,000 to 13,200 volts at which pressure the energy will be carried to the main station of the Minneapolis General Electric Company, where it is again reduced to 2,300 volts. The present pole line is nearly one side of a 60-ft. private right of way, leaving room for a second pole line to be erected when the installation is complete.

A HIGH BRIDGE.—It is stated that the famous Royal Gorge, near Canon City, Col., will be spanned by a bridge to be used in connection with an interurban electric railway system in Fremont County. The bridge will be 2,800 ft. above the hanging bridge of the Denver & Rio Grande Railroad at the bottom of the canon.

ANOTHER BIG CONTRACT LET.—The Southern Power Company has purchased another big order of electrical machinery which is to be used in the equipment of the transmission line from Great Falls up the river to the Catawba Power Plant, near Rock Hill, S. C. The contract for $50,000 worth of transformers, switchboards and other supplies has been let to the General Electric Company. This is in addition to the contract for $250,000 made some time ago with the Westinghouse Company for equipment to be used in the plant at Great Falls.

CHAIR OF ELECTRICAL ENGINEERING.—The council of Armstrong College, Newcastle, England, has decided to found a chair of electrical engineering in that institution. The policy of the authorities has been to make the college one of the foremost technical schools in the world, and it is realized that this worthy ambition could not be attained without paying attention to electricity. Moreover, Newcastle has become the center of a great development in its railways, shipyards, mines, etc., where facilities for study at first hand are presented on the spot, while some of the most important transmission enterprises in England have Newcastle as a focus.

OWNERSHIP AND FRANCHISES.—The American Academy of Political and Social Science, in its *Annals* for January, has devoted nearly the entire 258 pages to a treatment by various authorities and experts of the questions and data relative to "Municipal Ownership and Franchises." It is one of the most important and interesting monographs of the kind of recent publication and deals with results in London, New York, Glasgow, Chicago, Boston, Madrid, Baltimore, Philadelphia, etc., as well as such States as Missouri and Massachusetts. The writers are, in general, well-known men, and the arguments and facts presented are weighty. The part is issued at the price of one dollar, the society publishing its transactions every two months in this manner.

BROOKLYN MUNICIPAL TROLLEY.—In accordance with his declared intention, Borough President Coler, of Brooklyn, has prepared a bill for introduction in the Legislature this week to amend the charter so that the city may construct a municipal street railway in Brooklyn from the Bridge out to East New York, Jamaica, and points further east. Under the Coler bill the city would not necessarily operate the line. The tracks, stations and equipment would be constructed and furnished by the city and the Board of Estimate would have the power to lease the line to any existing road or to any new road for twenty-five years, with renewal privileges on revaluation. The bill provides that the construction of the road shall be under the direction of the Borough President. The Rapid Transit Commission is wholly ignored.

MUNICIPAL OWNERSHIP QUESTION AT LINTON, IND.—A proposition is before the City Council for the sale of the municipal electric lighting plant, which for the past six years has been owned by the city, and local sentiment is about equally divided as to whether municipal ownership in this case has proven a success or a failure. The plant is at present self-sustaining, but the rapid growth of the city has made it inadequate to the demands upon it. It is stated that about $18,000 must be expended in order to bring the plant up to present demands. The original price paid for the plant was $19,000, and the Indiana Electric Transmission Company now offers $15,000, the city to retain the ground upon which the buildings stand and which is quite valuable. The company, it is understood, further agrees to fix a rate as low as the present scale, to extend the service, move the plant to the edge of the city, furnish twenty-four-hour service, and to make this a central point for distribution of electricity for light and power to neighboring towns.

The Generating and Distributing of Music By Means of Alternators.

ONE of the most interesting applications of electricity which it has been our pleasure to record recently is found in the Cahill electric music-generating system, the general features of which are indicated in the accompanying illustrations.

Broadly considered, this music-generating system differs from previous systems of producing music in that it is purely electrical. Heretofore music has been produced by strings, reeds or pipes, which set the air in vibration. In some cases these vibrations of the air have been copied by a microphone and transmitted electrically to one or more telephones at a distance. But in all such systems of copying music electrically at a distance serious difficulties have developed. In the first place the vibrations of the air initiated by a violin, piano or organ are of but little power. A small fraction of this feeble power only is available to actuate the microphone. The microphone, as every one knows, has serious limitations. It magnifies feeble sounds, but is unable to magnify a loud sound. Further, the various transformations involved, first in changing the vibrations of the air into vibrations of the microphone diaphragm, then in producing from this diaphragm variations of the battery current; thirdly, in producing by induction from these variations in the primary corresponding vibrations in the secondary or line circuit, which (fourthly) in turn produce variations in the strength of the field of the receiving magnet at a distant point, which latter variations produce in their turn the vibrations of the receiving diaphragm and of the air—these many transformations result in a distortion of wave shape, which commonly entails serious injury to the musical beauty of the sound. Moreover, apart from any question of distorted waves and altered qualities, the sounds transmitted by microphones are feeble, so that it is usually necessary to hold the receiver to the ear—a condition which interferes seriously with musical enjoyment.

But in the system of generation invented and developed by Dr. Cahill, electrical vibrations are produced to initiate the sounds, which are as loud at each receiving station as if an orchestra were on the spot. A battery of alternators of different frequencies is used, answering in a general way to the strings of a piano or the pipes of an organ. One or more performers play upon piano keyboards. The keys of these operate switches, so as to bring the several alternators into action on the lines or mains as required. Across these mains receiving telephones are connected, just as incandescent lamps are in the Edison lighting system. With each receiving telephone a large paper horn is used. The net result of the system is that instead of the feeble vibrations of the air acting upon a microphone, and thus through numerous transformations as above detailed upon the receiving telephone, the performer is enabled to bring to bear upon the line the full power of a large alternator, or of a group of such alternators. These alternators are specially constructed so as to produce sounds whose purity and musical beauty exceed the finest pipe and closely approach a good string tone.

In no respect, then, it will be seen, is the electrical music like that from a mechanical piano or other mechanical musical instrument. In fact, there is no *musical* instrument in the system in the sense in which that word has been understood heretofore, for there is not a string or reed or sounding pipe in the whole apparatus. The vibrations in the first instance are purely electrical, and it is not until the electrical disturbance reaches the telephone receiver that the sound is produced. The performer listens to a receiving telephone just as his auditors do, a few feet, or it may be some miles, away. The wave distortions which the coils, line and diaphragm may produce in the wave forms transmitted is of little or no consequence, since the musician hears what his auditors hear, and if the coils and line and diaphragm tend to "rub down" the higher harmonics, he, all unconscious of this electrical action, simply sets the stops or presses the keys so as to produce the result his ear demands—and produces it.

FIG. 1.—ELECTRICAL MUSIC TRANSMITTER IN OPERATION.

Figs. 1 to 4 illustrate various portions of the inventor's first apparatus.

It is not the purpose of the present article to describe the mechanical details which are embodied in the construction of the electrical machinery, but merely to outline the general features of the apparatus. The generating set consists of a number of inductor alternators of simple construction. The fixed or stator part of each carries both the field and the armature windings. The rotors are mounted upon shafts; the shafts are geared together; and the number of teeth or poles in the several rotors and the angular velocities of the shafts are suitably arranged so as to produce the notes of the compass through five octaves. The tuning is remarkably good, and from the nature of things, absolutely unchangeable.

The armature coils, wound on the stators, are connected with switchboards, controlled by two keyboards, upon which the performer plays as on a piano, and a number of expression devices, which are actuated by his touch, make the hearer conscious that the soul of the musician is in the music. The depressing of a key closes a ground tone circuit and one or more other circuits

FIG. 2.—ELECTRICAL MUSIC RECEIVER.

corresponding to harmonics of that ground tone. A number of inductoriums or tone mixers serve to build up from the simple or sinusoidal waves of the alternators, complex resultant vibrations. Thus, several alternators contribute their waves to produce a single note, when that is of a rich or string quality. Several such notes on a single keyboard are combined electrically into more highly composite vibrations, which when they reach the ear appeal to it as musical chords of great beauty. In some cases the complex vibrations from different keyboards are further combined into still more highly composite vibrations, so as to produce several voices or parts as a violin and a 'cello, or a clarinet and flute in the same receiver at the same instant. Some of these superpositions of vibrations are produced conductively and some magnetically.

Without taking space to describe the exact details of these various vibration-combining devices, it may be said that they are special forms of inductoriums, having usually a plurality of primary circuits into which vibrations from different alternators are fed, and a combining secondary circuit in which resultant vibrations are produced, equivalent musically and electrically to the several series of vibrations in the several primary circuits. Some of these inductoriums have iron circuits almost closed; others have open iron circuits, while still others are air-core transformers—entirely without iron. Fig. 5 shows a "tone-mixer" in which the electrical vibrations are combined magnetically.

In a certain sense this system is a novel mode of distributing power electrically, the power being sent out in the shape of

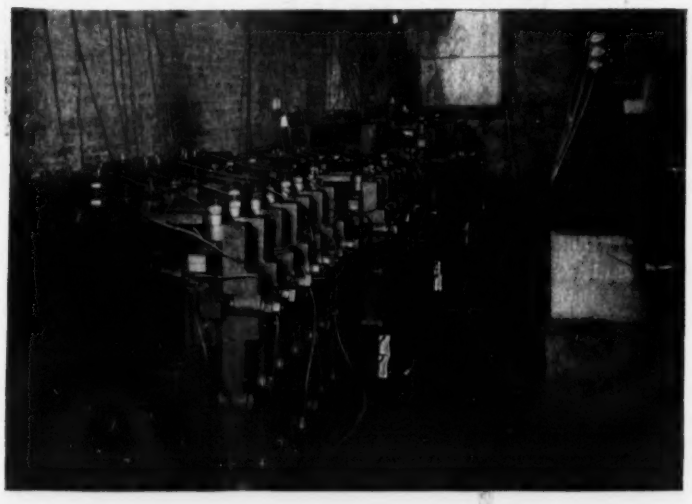


FIG. 3.—GROUP OF INDUCTOR ALTERNATORS, THE SOURCE OF POWER.

musical electrical waves so as to produce music perhaps in a thousand, or with a larger apparatus in ten thousand, parlors at the same time. The feature of using alternators for initiating the vibrations makes it possible to produce music at a great number of places simultaneously, with sounds soft or loud as the musician desires. Contrary to what one might suppose, the tones are remarkably pure and beautiful, nor is there the least suggestion of the friction and diaphragm noise that belongs to the phonograph, and the loud speaking telephone.

Apart from its interest as a means of distributing music from a central station, the Cahill system of original electrical generation has some musical possibilities which none of the existing instruments of music possess. Thus, for example, the intonation strikes the listener as remarkably good, and a glance at the steel inductors on the shafts and the steel gears connecting them shows that the tuning must be as permanent as it is perfect.

In the next place, the system of building up the quality of tone desired, by mixing with the ground tone one or many harmonics, with any strength desired, opens up a new field of timbre control. The wood-wind, brass and string tones of the orchestra are easily produced, by mixing the required harmonics in the required proportions. A musician in Dr. Cahill's laboratory showed our staff correspondent that a mere ground tone produces a clear, pure flute note, a ground tone with the third and fourth harmonics of suitable strength produces the sound of a clarinet, while to imitate the violin all the harmonics up to the eighth were necessary. Another combination of harmonics, in which the seventh and eighth are strong, gives the characteristic blare of brass. In addition to reproducing the leading orchestral tones, a skillful performer can mix the harmonics so as to produce

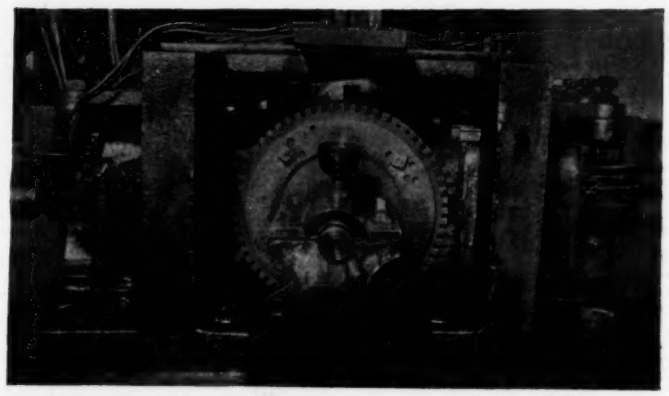


FIG. 4.—VIEW OF ROTOR OF HIGH-FREQUENCY INDUCTOR ALTERNATOR.

musical timbres unknown before. These new qualities are a striking feature of the electrical music.

Equally striking with this novel timbre control is the delicacy of the expression, dynamically considered. By the touch of the hand the performer controls the attack and sostenuto and varies the note at every instant. The musicians at the Cahill laboratory produced very good vibrato effects, and crescendos and diminuendos not inferior to those produced by a good violin. And when imitating the violin and 'cello the performer controlled, by his touch, the quality and power of the tone so perfectly that the auditor felt sure he heard the bow gliding across the string. The singularly pure quality of the tones and the remarkable control over them which the performer possesses take the listener by surprise. It is a curious system in which a battery of powerful alternators at a central station may be used to vibrate diaphragms all over a great city, producing music in thousands of homes, while the electrical forces are so perfectly under the control of the performers' fingers that they respond to their musical feelings more perfectly than any existing instrument, saving the violin, viola and 'cello.

Dr. Cahill has been engaged in perfecting his apparatus for years and it seems to have reached the commercial standpoint. That the installation has long since passed the experimental stage will be appreciated when it is known that there is now in use in the inventor's laboratory at Holyoke, Mass., in addition to the instrument already described a central station plant containing one hundred and forty-five directly-coupled inductor alternators. These alternators are arranged in eight sections or panels, each inductor being mounted on an eleven-inch steel shaft. The bed plate of the machine is built up of eighteen-inch steel girders, mounted on brick piers, and is more than 60 ft. long. The switchboards are in ten sections and contain nearly two thousand switches. These are controlled from a distant keyboard

through an electro-magnetic action. There are numerous transformers, one of which is seen in Fig. 5, and many rheostats and other regulating devices, including in the aggregate thousands of coils or sections. The whole plant weighs nearly two hundred tons, and has cost approximately two hundred thousand dollars. This apparatus was built for lease to the New England Electric Music Company, of which Mr. F. C. Todd is president. A second large apparatus is well under way and is likely to be completed in two or three months.

The inventor's first complete apparatus, which is illustrated in the drawings, and which we have described, was built in Washington some years ago. The larger work has been done at Holyoke, where the Cahill laboratory has been located for the last four years.

From the superficial description given above it is evident that the constructional features of the electrical mechanism are exceedingly elaborate. It is believed, however, that the results obtained fully justify the means employed. There can be no doubt as to the absolute accuracy of the relative pitches of the various notes produced, nor as to the beauty and purity of the resultant music. Although the horn of the receiver resembles that of a phonograph, there is nothing about the music itself to suggest

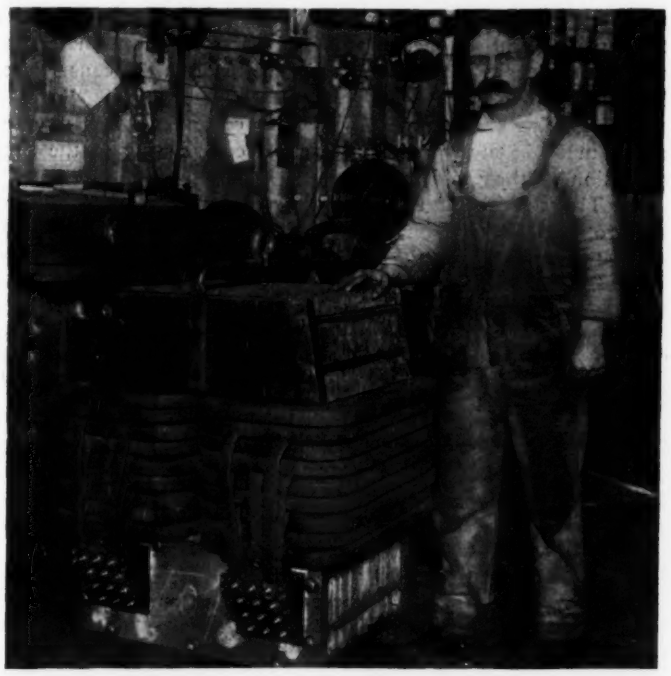


FIG. 5.—TONE-MIXING TRANSFORMER.

the phonograph, the harsh sounds and disagreeable overtones of which are entirely lacking. The quality of the sound is pure and sweet and the volume is such that the largest known auditorium can be served without the use of an excessive number of receivers, while the character and expression of the music is under the control of the musician to an extent not previously reached in any musical instrument.

The question will naturally arise in the mind of the reader as to the practical use of this complicated and expensive apparatus. The plans of the inventor are to distribute music from a central station to hotels, restaurants, theatres and private homes. The remarkable purity and strength of the sounds produced electrically, enabling a few performers at a central station to produce orchestral music at a thousand places, strikes the imagination and it seems not improbable that at no distant day orchestral music for the dinner table will be as common in the homes of the people as it is now in the great hotels. Music of different sorts during the evening and slumber music during the small hours of the night, coming to the listener by electricity from a central station, seem likely in a few months to be accomplished facts in one or more American cities.

Dr. Cahill's work is covered, it is said, by numerous patents and pending applications in this country and abroad.

Electrical Engineering Classification.

BY ALLEN S. PEARL.

Referring to the excellent article by Mr. George Parsons in the ELECTRICAL WORLD AND ENGINEER of November 25, 1905, on "A Topical Classification for Electrical Engineering References," and the comments thereon by Mr. A. G. Voge in the issue of January 20, the writer has put in use a similar classification adapted to the needs of an electrical supply house correspondent or purchasing agent which apparently embodies the greatest simplicity, ease of reference and flexibility, with a minimum amount of clerical work to keep in working condition. A filing cabinet is used with three vertical rows of drawers, the contents of which are arranged in the same order as material in the general catalogue of the supply house. Beginning at the upper left drawer these are marked with cards as follows:

1.	Pages 9 to 36.	Switches and accessories.
2.	Pages 67 to 125.	Cut-outs and fuses.
3.	Pages 126 to 162.	Sockets and fittings.
4.	Pages 103 to 253.	Fixtures and fittings.
5.	Pages 254 to 255.	Signs and flashes.
6.	Pages 256 to 271.	Incandescent lamps.
7.	Pages 272 to 286.	Arc lamps and arc lamp sundries.
8.	Pages 287 to 288.	Marine supplies.
9.	Pages 289 to 300.	Insulating material (mica cloths, etc.).
10.	Pages 301 to 356.	Pole line material.
11.	Pages 357 to 413.	Tools.
12.	Pages 414 to 442.	Wires and cables.
13.	Pages 443 to 462.	Conduit and fittings.
14.	Pages 463 to 498.	Insulations and fittings.
15.	Pages 499 to 543.	Instruments and transformers.
16.	Pages 544 to 567.	Switchboards, panel boards.
17.	Pages 568 to 576.	Dynamo brushes and commutators.
18.	Pages 577 to 591.	Circuit breakers and lightning arresters.
19.	Pages 592 to 594.	Dynamos and motors.
20.	Pages 595 to 610.	Rheostats and dimmers.
21.	Pages 611 to 627.	Telephones and accessories.
22.	Pages 628 to 642.	Bells and annunciators.
23.	Pages 643 to 672.	Batteries and pushes.
24.	Pages 673 to 678.	Automobile supplies.
25.	Pages 679 to 690.	Speaking tube supplies, novelty goods and blasting apparatus.
26.	Pages 691 to 713.	Gas lighting and burglar alarm supplies, fire alarm and telegraph apparatus.
27.	Pages 714 to 724.	Heating apparatus.
28.	Page 730	Sewing machine motors, fan motors and exhaust fans.
29.	Pages 730 to 745.	Tables.

The index to the general catalogue thus becomes an index as well to the contents of the cabinet, showing in which drawer a circular describing a given article may be found, as all circulars describing switches and accessories are put in drawer 1, etc. If in doubt under which class an article comes, all that is necessary to do is to find its name in the index of the general catalogue, and the page number shows in which drawer its descriptive circular may be found. Each drawer is indexed alphabetically and the circulars are filed under the names of the firms issuing them. If a circular covers more than one class of material, several copies are used, one being filed in each drawer containing circulars of one of the classes covered, no cross-indexing therefore being necessary. Should a drawer be filled, another drawer below it is used for *L* to *Z* circulars, shifting the succeeding drawers on one space. A few extra copies of circulars may be kept to enclose with quotations. Notes, articles, quotations, advertisements, etc., are filed with the circulars. By marking the discounts on the front page of each circular not intended for enclosure, a complete cost system is maintained, no "cost book" with its clerical work being necessary. When it is remembered that one discount usually applies to an entire circular, the amount of labor necessary to keep a cost record in this way as compared with a cost book record with a page for each item, is apparent.

With such a cabinet, and after filing for a few months the new circulars that come daily in the mail, new advertisements in the electrical journals, etc., a correspondent is able to quote instantly on almost any article on the market.

Anyone who has been called upon to quote on or purchase an article of which he has a dim recollection of having seen described "somewhere" some time, and which is not being advertised in current periodicals, will appreciate the immense amount of time saved by being able to lay hands upon a drawer containing a descriptive circular. It is then an easy task to run through the contents of one drawer unless the name of the manufacturer is known, in which case one can open the file to the circular at once.

Commutation in Single-Phase Motors at Starting.

By Marius Latour.

THE use of the single-phase motor for traction purposes in the future depends essentially on the way the difficulties connected with the commutation at starting are overcome. It is therefore surprising that the authors who have treated the different diagrams referring to the single-phase motor have neglected this phase of the subject.

I have published in the Electrical World and Engineer of December 3, 1904, an article treating the conditions of commutation at starting in the case of a motor without resistance leads. By theoretical considerations the conclusion was reached that from the point of view of commutation at starting all types of motors are alike, and that the improvements that one might expect to produce by changing the number of poles, the speed of the motor, etc., are rather illusory.

In the same article, however, was shown the desirability of obtaining the required voltage of the rotor by means of a winding which gives the largest possible number of bars on the commutator, so that for a reduced width of the brush (9 to 12 mm.) several bars are still covered by the latter. It was also shown that the voltage of the rotor must be so chosen that the potential difference between two consecutive bars under the brush stands in a certain relation to the ohmic drop due to the line current in the brush. In the case when two bars are covered, for instance, this relation is represented by the formula:

$$e = \sqrt{2.4\ k}$$

in which e represents the voltage per bar and k the ohmic drop of the line current in the brush. With most resistant carbon brushes e cannot very well exceed in general 2.5 volts, even for a commutation corresponding to an evolution of 40 watts per square cent. of the surface of contact.

The voltage for a single-phase motor at 25 cycles giving the minimum rubbing surface for such a commutation (40 watts per square centimeter) would consequently lie below 200 volts. If, therefore, it proves to be necessary to use the same motor as a 250-volt direct-current machine, the conditions for commutation become unfavorable. The low voltage suitable for a single-phase motor has besides the disadvantage of necessitating the introduction of large currents into the rotor. This disadvantage disappears, however, in the case of the repulsion motor where the current is generated in the rotor itself as well as in the case of a compensated repulsion motor of my type in which one has to introduce only the magnetizing current.

In the study of commutation contained in the article, referred to above, the average quantity of heat developed per square cent. and per second under the brush was taken as a criterion of the quality of commutation. The general mathematical treatment of the commutation based on the consideration of the heat produced under the brush has been applied by Mr. Th. Reid (see *Transactions* of the American Institute of Electrical Engineers, May, 1905) to the case of direct-current machinery. Mr. Reid lays special emphasis on the quantity of heat which is produced at the very edge of the brush. It is evident that a complete theory of the sparking in the process of commutation must consider both the total quantity of heat developed under the whole surface of the brush divided by the surface of contact and the quantity of heat per square centimeter which is produced at the edge of the brush. The authors who studied the commutation at first committed the error of considering only the voltage between brush and bar at the moment when the short-circuit is opened as a criterion of the commutation, neglecting all the conditions which preceded the breaking of contact. The theory which would consider only the edge, and neglect the fact that the conditions at the edge are influenced by the conditions prevailing at the neighboring portion of the brush, would also be inadequate. In the first theory no integration at all is performed; in the second the integration performed refers only to the time, while in the theory applied in my article mentioned above integration is performed with respect to both time and space. In reality none of these three points of view considered separately gives a complete representation of the phenomena taking place, and accordingly none of them is a perfectly true measure of the quality of commutation.

However, when no resistance leads are used, experiments show that single-phase traction motors constructed in accordance with the requirements of the theory developed in the article mentioned above give a perfect commutation at starting. As the quantity of heat generated on the commutator is minimum, and as this result is obtained with the minimum of rubbing surface, according to this method, the other two methods mentioned above cannot possibly lead to any further improvement.

In the case when resistance leads are used, the dissymmetry in the behavior of the brush as a whole and of the edge is increased to such an extent, and the difference between the quantities of heat generated per square centimeter when referred to the whole surface of the brush or only to its edge is so large, that for the complete study of commutation all three points of view mentioned above must be applied conjointly.

In what follows, a study is made of the commutation when resistance leads are used. I have already shown (see Electrical World and Engineer, January 16, 1905) that the resistance leads allow the rubbing surface on the commutator to be reduced for the same amount of energy produced per square centimeter under the brush, and the use of resistance leads might consequently be of great help.

In beginning the study, it is well to call attention to the remarks made in my previous articles as contributing to the simplification of the problem:

1st. The starting of the motor is considered to be equivalent to a rotation with an infinitely small velocity so that the e.m.f. generated by speed in the short-circuited coil need not be considered. The division of the line current in the different leads and the value of the short-circuit current are regulated merely by the interposed ohmic resistances in accordance with the Kirchhoff law, the local reactance of the short-circuited coil being considered negligible.

2d. The short-circuit current in a single-phase motor can be considered to be approximately in quadrature with the line current if one neglects the leakage reactance of the short-circuited coils. It follows from this remark that it is permissible to calculate separately the quantities of heat produced by the short-circuit current and by the line current and to add them afterwards.

Let us first study the commutation, taking as a criterion the voltage between brush and bar at the moment when the brush leaves the bar. Consider Fig. 1, in which the brush covers three

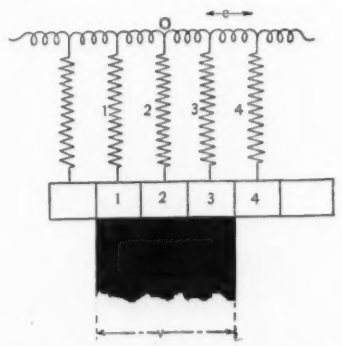


FIG. 1.—BRUSH COVERING THREE WHOLE SEGMENTS.

bars. Let e be the e.m.f. developed in each coil by the variations of the field of the motor and assume at first that no current is introduced through the brush, so that the short-circuit current alone flows in the short-circuited coil. By reason of symmetry the conductor, 2, is free of current. The potential of the brush is accordingly the same as that of the point, O, of the winding. Under these conditions the difference of potential between the brush and the bar 4, which it is just leaving, equals $2e$. If the brush covered m bars the difference of potential, v_1, between the brush and the bar leaving the brush would be

$$v_1 = \frac{m-1}{2}e + e = \frac{m+1}{2}e.$$

Let v represent the difference of potential developed on the commutator over a length equal to the width of the brush.

Then one has:

$$m e = v$$
$$e = \frac{v}{m}.$$

Consequently the potential difference between the brush and the bar which the brush is leaving will be equal in the moment of rupture to:

$$v_1 = \frac{m+1}{2m}v.$$

These considerations show that if the width of the brush is given in addition to the value of v (that is to say, the voltage of the motor is known indirectly), then it is advisable to choose a winding which gives the largest number of bars under the brush in such a way as to subdivide the voltage, v, as much as possible. However, with a winding capable of giving a very large value to m, v_1 cannot be reduced below the limiting value, which is equal to $\frac{v}{2}$. Since with two bars, and with three bars, covered by the brush, one has, respectively,

$$v_1 = \frac{3}{4}v$$
$$v_1 = \frac{2}{3}v$$

it is seen that the sub-division of the voltage, v, into two or three parts is practically sufficient, especially if one considers that a small further reduction of v_1 involves the use of a much more expensive winding and commutator.

In studying the commutation at starting from the point of view of the quantity of heat produced under the brush per square centimeter, in the case where no resistance leads are used practically the same conclusions have been arrived at. It can be shown that for an infinite value of m, and the voltage, v, short-circuited under the brush indefinitely sub-divided, the quantity of heat produced under the brush by the short-circuit current can be reduced to one-half of the value corresponding to $m = 1$.

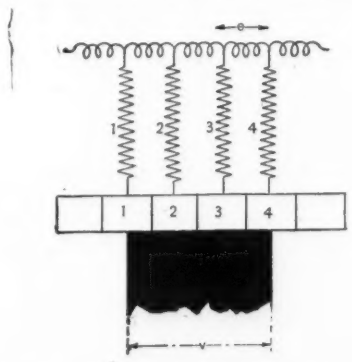


FIG. 2.—BRUSH COVERING TWO WHOLE AND TWO HALF SEGMENTS.

With two bars under the brush, one finds, however, that the quantity of heat per square centimeter is already reduced to 5/8 of the same value. Both points of view lead accordingly to the same conclusion, that is, that two or three bars under the brush are practically sufficient.

In what follows, it will be assumed that three bars are used under the brush in connection with resistance leads.

Let us call I the line current introduced through the brush, S the total surface of contact between brush and commutator bars, $s = \frac{S}{3}$ the surface of contact for a single bar, r the resistance of the resistance leads, ρ the resistance per square centimeter of the contact (1) and let β be the ratio $r : \frac{\rho}{S}$. If we consider only the circulation of the line current through the brush and the resistance leads, we see that the difference of potential between the brush and the bar, 4, leaving the brush will be:

$$\frac{I}{3}\frac{\rho}{s}(1+\beta).$$

Taking now into account the voltage produced by the variation of the field of the motor, the resultant voltage between the brush and the bar, 4, will be:

$$\sqrt{\left[\frac{I}{3}\frac{\rho}{s}(1+\beta)\right]^2 + \left[\frac{2}{3}v\right]^2}$$

As was shown in the previous article, the product (vI) depends only on the capacity of the motor. For a given armature provided with given resistance leads and out of which we must get a certain starting torque the minimum of the expression above will consequently be reached when

$$\frac{I}{3}\frac{\rho}{s}(1+\beta) = \frac{2}{3}v = 2e.$$

This would mean that the short-circuit e.m.f. e between two consecutive bars should be chosen equal to one half of the ohmic drop through the brush and the resistance leads due to the line current.

Let us now study the commutation taking as a criterion the average quantity of heat produced per second and per square centimeter under the brush.

We shall calculate separately the quantities of heat produced by the line current and by the short-circuited current. Let us call i_1, i_2, i_3, i_4 the parts of the line current, I, which flow in the resistance leads 1, 2, 3 and 4, respectively. Let us call x the ratio between the surface, s_1, of the bar 1 covered by the brush and the total surface, s, of that bar which can be covered by the brush.

The resistances interposed between the brush and the winding are, respectively,

$$\frac{\rho}{s}\left(\frac{1}{x}+\beta\right)$$
$$\frac{\rho}{s}(1+\beta)$$
$$\frac{\rho}{s}(1+\beta)$$
$$\frac{\rho}{s}\left(\frac{1}{1-x}+\beta.\right)$$

In accordance with the Kirchhoff laws we have then the following equations:

$$(1)\quad i_1\frac{\rho}{s}\left(\frac{1}{x}+\beta\right) = i_2\frac{\rho}{s}(1+\beta) = i_3\frac{\rho}{s}(1+\beta) = i_4\frac{\rho}{s}\left(\frac{1}{1-x}+\beta\right)$$

$$(2)\quad i_1 + i_2 + i_3 + i_4 = I.$$

From these equations one calculates:

$$i_1 = I\cdot\frac{1+\beta}{2(1+2\beta)}\cdot\frac{x\left(x-\frac{1+\beta}{\beta}\right)}{x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}}$$

(1) In what follows the assumption is made that ρ has a constant value for all current densities. This would not be true for low-current density, but is approximately true for the very high densities which are used in the starting of single-phase motors.

$$i_3 = I \cdot \frac{\beta}{2(1+2\beta)} \cdot \frac{x^2 - x - \frac{1+\beta}{\beta^2}}{x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}}$$

During the time the bar, 1, enters under the brush and the bar, 4, leaves the brush, the total quantities of heat produced under the brush by the currents, i_4 and i_3, are respectively equal to the total quantities of heat produced under the brush by the currents, i_1 and i_2.

The average quantity of heat produced per second under the brush by the currents, i_1 or i_4, will be:

$$\frac{\rho}{s} I^2 \frac{(1+\beta)^2}{4(1+2\beta)^2} \int_0^1 \frac{x\left(x - \frac{1+\beta}{\beta}\right)^2}{\left[x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right]^2} dx$$

The average quantity of heat produced per second under the brush by the currents, i_2 or i_3 will be:

$$\frac{\rho}{s} I^2 \frac{\beta^2}{4(1+2\beta)^2} \int_0^1 \frac{\left[x^2 - x - \frac{1+\beta}{\beta^2}\right]^2}{\left[x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right]^2} dx$$

The average of the total quantity of heat produced per second under the brush by the line current, I, will then be:

$$\frac{\rho}{s} I^2 \frac{1}{2(1+2\beta)^2} \left[(1+\beta)^2 \int_0^1 \frac{x\left(x - \frac{1+\beta}{\beta}\right)}{\left[x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right]^2} dx + \beta^2 \int_0^1 \frac{\left(x^2 - x - \frac{1+\beta}{\beta^2}\right)^2}{\left(x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right)^2} d. \right]$$

This power divided by the total surface $S = 3s$ of the brush gives:

$$q_1 = \rho \frac{I^2}{S^2} \cdot \frac{3}{2(1+2\beta)^2} \left[(1+\beta)^2 \int_0^1 \frac{x\left(x - \frac{1+\beta}{\beta}\right)^2}{\left[x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right]^2} dx + \beta^2 \int_0^1 \frac{\left(x^2 - x - \frac{1+\beta}{\beta^2}\right)^2}{\left(x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}\right)^2} dx \right] = \rho \frac{I^2}{S^2} f_1(\beta).$$

$f_1(\beta)$ must be considered as a numerical coefficient by which the quantity of heat produced by the line current under the brush when no resistance leads are used, must be multiplied in order to obtain the actual quantity of heat produced by the line current when the resistance leads used have β times more resistance than the contact resistance per bar.

In order to calculate the quantity of heat liberated by the short-circuit current, let us call j_1, j_2, j_3, j_4 the different values of the short-circuit current in the conductors, 1, 2, 3, 4. According to the Kirchhoff laws we have the equations:

$$j_1 \frac{\rho}{s}\left(\frac{1}{x} + \beta\right) - j_2 \frac{\rho}{s}(1+\beta) = e$$

$$j_1 \frac{\rho}{s}\left(\frac{1}{x} + \beta\right) - j_3 \frac{\rho}{s}(1+\beta) = 2e.$$

$$j_1 \frac{\rho}{s}\left(\frac{1}{x} + \beta\right) - j_4 \frac{\rho}{s}\left(\frac{1}{1-x} + \beta\right) = 3e.$$

$$j_1 + j_2 + j_3 + j_4 = 0.$$

The total quantity of heat produced per second and per square centimeter under the brush will be:

$$q_i + q_j = \rho \frac{I^2}{S^2} f_1(\beta) + \frac{e^2}{\rho} f_2(\beta).$$

As the product (eI) is given by the starting torque, this quantity will be the minimum when

$$q_i = q_j$$

or when

$$\rho \frac{I^2}{S^2} f_1(\beta) = \frac{e^2}{\rho} f_2(\beta),$$

or when, if we call k the ohmic drop due to the line current in the brush, for the average current density $\frac{I}{S}$

$$e = k \sqrt{\frac{f_1(\beta)}{f_2(\beta)}}.$$

Let us now study the commutation, taking as a criterion the average quantity of heat produced per second and per square centimeter at the edges of the brush.

The current density at the edge of the brush bearing on the bar, 1, will be the resultant of the current density δi due to the line current and the current density, δj, due to the short-circuit current. The average quantity of heat produced per second and per square centimeter will be the average value of

$$\rho\, \delta i^2 + \rho\, \delta j^2.$$

As we know the value of i_1 and j_1, it is very easy to determine each one of these quantities. We have

$$\delta i = \frac{i_1}{s_1} = \frac{I}{S} \frac{3(1+\beta)}{2(1+2\beta)} \frac{x - \frac{1+\beta}{\beta}}{x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}}$$

$$\delta j = \frac{j_1}{s_1} = \frac{e}{\rho} \frac{3}{2\beta} \frac{x - \frac{2(1+\beta)}{1+2\beta}}{x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}}.$$

Finally, we obtain for the quantity of heat, $q\delta i$, produced per second and per square centimeter at the edges of the brush by the line current,

$$q\delta i = \rho \frac{I^2}{S^2}\left[\frac{3(1+\beta)}{2(1+e\beta)}\right]^2 \int_0^1 \left(\frac{x - \frac{1+\beta}{\beta}}{x^2 - x - \frac{3(1+\beta)}{2\beta(1+2\beta)}}\right)^2 dx =$$

$$\rho \frac{I^2}{S^2} f_3(\beta).$$

From those equations one calculates:

$$j_1 = 3\,e\,\frac{s}{\rho}\,\frac{1}{2\beta}\,\frac{x\left(x-\dfrac{2\,(1+\beta)}{1+2\beta}\right)}{x^2-x-\dfrac{3\,(1+\beta)}{2\beta\,(1+2\beta)}}$$

$$j_2 = e\,\frac{s}{\rho}\,\frac{1}{2\,(1+\beta)}\,\frac{x^2-x-\dfrac{3\,(1+\beta)}{\beta\,(1+2\beta)}\,(1-x)}{x^2-x-\dfrac{3\,(1+\beta)}{2\beta\,(1+2\beta)}}$$

It follows from the same considerations we have exposed in studying the quantity of heat produced per second under the brush by the line current that the average quantity of heat produced per second and per square centimeter under the brush by the short-circuit current is:

$$q_j = \frac{e^2}{\rho}\cdot\frac{3}{2}\left[\frac{1}{\beta^2}\int_o^1 \frac{\left(x-\dfrac{2\,(1+\beta)}{1+2\beta}\right)^2}{\left[x^2-x-\dfrac{3\,(1+\beta)}{2\beta\,(1+2\beta)}\right]^2}\,dx + \right.$$

$$\left.\frac{1}{g\,(1+\beta)^2}\int_o^1 \frac{\left(x^2-x-\dfrac{3\,(1+\beta)}{\beta\,(1+2\beta)}\,1-x\right)^2}{\left(x^2-x-\dfrac{3\,(1+\beta)}{2\beta\,(1+2\beta)}\right)^2}\,a\,x\right] = \frac{e^2}{\rho}\,f_2\,(\beta)$$

$f_2\,(\beta)$ being again a numerical coefficient like $f_1\,(\beta)$; and for the quantity of heat, $q\delta j$, produced by the short-circuit current:

$$q\delta j = \frac{e^2}{\rho}\,\frac{g}{4\beta^2}\int_o^1 \frac{\left(x-\dfrac{2\,(1+\beta)}{1+2\beta}\right)^2}{\left(x^2-x-\dfrac{3\,(1+\beta)}{2\beta\,(1+2\beta)}\right)}\,dx = \frac{e^2}{\rho}\,f_4\,(\beta)$$

$f_3\,(\beta)$ and $f_4\,(\beta)$ are, like $f_1\,(\beta)$ and $f_2\,(\beta)$, numerical coefficients. As the product $(e\,I)$ is given, and is constant, the total power lost, $q\delta i + q\delta j$, will be minimum when $q\delta i = q\delta j$, or when

$$\rho\,\frac{I^2}{S^2}\,f_3\,(\beta) = \frac{e^2}{\rho}\,f_4\,(\beta),$$

which implies the relation:

$$e = k\,\sqrt{\frac{f_3\,(\beta)}{f_4\,(\beta)}}.$$

The values of the coefficients, $f_3\,(\beta)$ and $f_4\,(\beta)$ are given as soon as one knows the finite integral:

$$\int_o^1 \frac{(x-a)^2}{(x^2-x-b)}\,dx = \frac{1}{2b} + \frac{2a\,(a-1)}{b\,(1+4b)} \cdot$$

$$+\frac{4\,(a^2-a-b)}{(1+4b)^{3/2}}\cdot log\,\frac{\sqrt{1+4b}+1}{\sqrt{1+4b}-1}$$

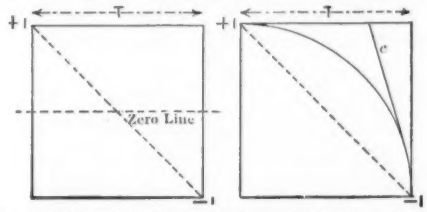
As to the finite integrals contained in $f_1\,(\beta)$ and $f_2\,(\beta)$, they do not present any special difficulty, but they give more complicated expressions. For that reason, it is intended in a subsequent article to publish the mere geometrical representation of $f_1\,(\beta)$, $f_2\,(\beta)$, $f_3\,(\beta)$ and $f_4\,(\beta)$, when β varies from $\beta = 0$ (which value of β corresponds to leads of negligible resistance) to $\beta = 5$ (which value of β corresponds to resistance leads of a comparatively very high resistance). In the same article will be given the corresponding curves when only one bar, and when two bars are covered by the brush, so that a general numerical discussion will be possible.

Calculation of Dynamo Sparking Constants.

BY A. PRESS.

THE elements entering into commutation theory are so numerous that a shortened form of calculation must be of paramount importance to the designing engineer. As has already been shown (see ELECTRICAL WORLD AND ENGINEER, December 16, 1905), there are three criteria of sparking. The one depends upon the magnetic momentum of the short-circuited coil; that is, the flux linkages, which change from one direction to the opposite. The second is the voltage generated in the coil due to the coil cutting lines of force, and the third is the voltage drop in the short-circuited coil spanned by the tip of the brush at the last instant.

Fig. 1 gives a graphic representation of the current in the short-circuited coil during the period of commutation with no self-

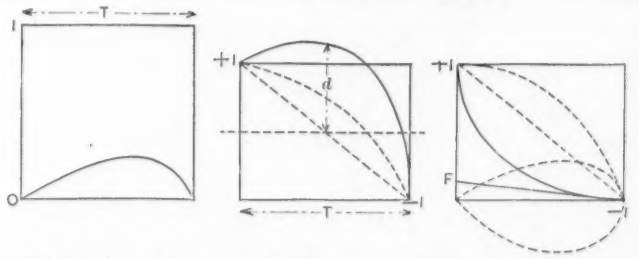


FIGS. 1 AND 2.—COMMUTATION WITHOUT AND WITH SELF-INDUCTION.

induction and no voltage generated, because of field distortion, at the neutral position of the brushes. Should self-induction be present, the curve will no longer be a straight line, but it will take the form shown in Fig. 2. Obviously the tangent at the last instant (shown by C) will determine whether the current density at the time the brush leaves the segment will be excessive or not (see ELECTRICAL WORLD AND ENGINEER, December 16, 1905). This condition is determined by $\frac{I\,L}{T}$. I is the current per circuit, L the self-induction of the coil short-circuited, and T the time of commutation. The expression $\frac{I\,L}{T}$ will be designated by S_C. The practical limit is given by

$$\frac{I\,L}{T} = S_C < 2.$$

The theoretical limit is .5. The difference between theory and practice exists because, due to the high frequency of commutation, the actual self-induction is about ¼ on the whole of what is ordinarily calculated. Due, however, to the coils cutting lines of force, which lines are set up by the armature ampere-turns not undergoing commutation, there will be an extra current present because of the generated voltage. The form of this extra current is shown in Fig. 3. This extra



FIGS. 3, 4 AND 5.—EXTRA CURRENT OF COMMUTATION DUE TO SPEED-GENERATED VOLTAGE.

current must be added to the current shown in Fig. 2 and thereby one arrives at Fig. 4. An inspection of Fig. 4 will show that if the generated voltage is high enough the current density in the brush may reach such high values that glowing may occur. The point of glowing depends upon the quality of the brush and is in the neighborhood of 100 amp. per sq. in. A point of high current density is indicated by the ordinate, d. The generated voltage just spoken of will be designated by R_V and should not exceed 10 in value. If

σ = number of commutator bars covered by the brush,
t = turns per coil,
K = kilowatts output or input,

p = number of poles,
F = flux in mega lines per pole,
l = gross length of armature iron in inches,

then $R_v = \sigma \times \frac{6.12}{100} \times t \times \frac{K}{p F} \times l'' < 10.$

Theoretically, the constant used above should be 3.06 instead of 6.12.

Referring again to Fig. 4, to obtain good commutation, the resultant curve as shown has to be modified to bring it as close to the straight line curve of Fig. 1 as will insure good commutation. This is done by so adjusting the position of the brushes as to cause an actual negative, R_v, which corrects for the former positive R_v, and even the upward bulging in the commutation current curve shown in Fig. 2. Thus by adding the negative, R_v, to Fig. 4 one obtains finally Fig. 5. The tangent at the last instant is now shown by F. The negative, R_v, is obtained by moving the brushes forward or backward so as to obtain a commutating field.

The condition $S_c = \frac{I L}{T}$ includes all the members entering into the equation for R_v. There is, however, one correcting term which if calculated will enable one to determine the former without difficulty. This factor is the number of lines per centimeter-ampere that the coil generates, expressed as Σ. In other words, it is a self-induction factor. Thus:

v = ventilating factor = $\frac{\textit{net length of armature iron}}{\textit{gross length of armature iron}}$.

ϕ = a mutual induction factor, and its magnitude depends on whether the coils undergoing commutation at two brushes simultaneously lie in the same slots or not. This factor is 1.0 for full cord windings and is .5 for fractional pitches when the actual pitch differs from the full pitch by at least one tooth.

λ_a = lines per centimeter-ampere of conductor for open-type slots, with mutual induction; one may take $\lambda_a = 1.25 \rho$.

ρ = ratio of depth of slot to width of slot.

l_s = length of single end connection.

l = gross length of armature.

λ_s = lines per centimeter-ampere for the end connections.

$$\Sigma = v \phi \lambda_a + \frac{l_s}{l} \lambda_s.$$

The end connection self-induction is given by the formula:

$$\lambda_s = .46 \left\{ log \left(\frac{l_s}{d_s} \right) - .2 \right\}$$

This is of course based upon the self-induction of two parallel wires. The term d_s stands for the diameter of a circle giving the area of one-half of the slot. The theoretical value for λ_a at ordinary frequencies is $\frac{1.25 \rho}{.5}$, the lines above the top of slot being neglected. The reasonableness of the short formula, $\phi \lambda_a = .625 \rho$, with $\phi = .5$, is easily perceived when one observes that the theoretical value is $.43 \rho$ under the limitation specified.

Having obtained the value of Σ, S_c is given by

$$S_c = \frac{R_v \cdot \Sigma}{12}.$$

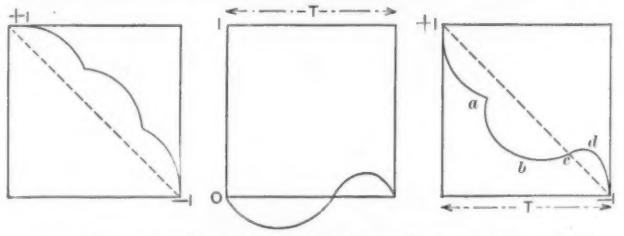
This apparent S_c has to be divided by the voltage drop per brush to obtain the real S_c, which is a measure of the sparking qualities. It should be less than 2. The third criterion is of importance when the S_c is near the limit, 2, in which case the copper drop per coil is the determining factor. Designating by W_t the resistance of the commutated coil in ohms and by $I W_t$ as the copper drop,

$$W_t = \frac{1.575 \times 10^{-8} \times t \times (l + l_s)''}{A}.$$

where A is the area of conductor in square inches. The ratio of $\frac{I W_t}{V}$ should be less than .12. The symbol V stands for the brush voltage drop.

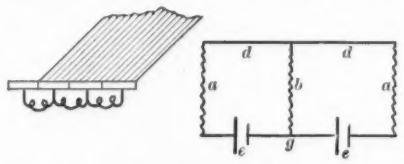
These formulæ will be found quite easy of computation, and have been checked over for a very large number of machines. In every case the sparking qualities have been determinable from the magnitude of the sparking constants.

It may be interesting to add that from the character of the burning at the brush the form of the current curve of commutation can be pretty fairly conjectured. Thus, in a case when there was a distinct marking on a brush, it would be foretold that the brush occupied the actual neutral field position. In this instance there were three bars covered. The first part of the brush was highly polished, the second rather dullish and the third distinctly burned. Evidently the brush commutated properly in the first part of the time, and in the last stages of commutation the coil was poorly commutated. The curve, neglecting the cross field, would have been as shown in Fig. 6. The R_v current of commutation because of brush position with respect to the field is shown in Fig. 7. Superimposing Figs. 6 and 7 one obtains Fig. 8. The parts $a\,b\,c$ and $c\,d$ give the dulled portions of the brush. It may be objected that the commutation of more than one coil simultaneously by increasing the time of commutation faster than the added mutual induction of the added coils would, presumably, benefit commutation. This, however, is a false view since it takes notice of only part of the whole actual phenomenon. What really causes the commutation to become worse is that the coils short-circuited are not in parallel, but in series. The added mutual induction is part only of the consequence of covering more than one brush.



FIGS. 6, 7 AND 8.—COMMUTATION CURRENT WITH THREE BARS COVERED BY THE BRUSH.

Those who have had some experience with the multi-voltage systems will easily follow the subjoined reasoning. Referring firstly to Fig. 9 with three bars covered, as shown, there are two generated electromotive forces in series and the diagram reduces to Fig. 10. The limbs a, b, a represent contact resistances. The line $d\,d$ is a short-circuiting strip which represents the negligible resistance of the brush. It is now obvious that the strip $d\,d$ must be at half potential relative to the end of a cell that is to the point g. Joining the limb $d\,d$ to the cells $e\,e$ by means of b, only makes an equipotential contact. It must, therefore, result in a condition of things in which the two cells are virtually in series. The same sort of reasoning applies to three cells or more. In all cases the short-circuiting strip will be at one-half the potential of the entire number of cells short-circuited. The mathematically-inclined can check the result, however, by means of Kirchoff's laws and by adopting the Strutt method of networks. Thus in the formula given above the magnitudes of both the S_c and the R_v depend upon the number of commutator segments covered by the brush proportionately.



FIGS. 9 AND 10.—REPRESENTATION OF ELECTROMOTIVE FORCES WHEN THE BRUSH COVERS THREE BARS.

In the former article upon commutation, in the formula for the R_v current, the self-induction drop of the coil was neglected. Taking the latter into account, results in the criteria themselves

remaining the same; but the formula for the current density at the last instant becomes

$$i_a'' = I_a \left\{ \frac{1 + \frac{IW}{V} + \frac{R_v}{V}}{1 - \frac{L}{RT}} \right\}$$

At the Asheville meeting of the A. I. E. E. there occurred an extended discussion on a paper having the title "Limitations in Direct-Current Machine Design," and Mr. Senstius, the author, contended that the limit of capacity of a 300-volt generator was 1,800 kw, a point to which Messrs. Dunn and Steinmetz called particular attention, stating that at the Edison stations in Chicago and Cincinnati 2,500-kw, 300-volt generators were in operation showing in Mr. Steinmetz's words that "the deductions in the paper on 'Limitations in Direct-Current Machine Design' were expressed more broadly than warranted." The facts show that these machines operate satisfactorily, and this is entirely borne out by the formulæ given above.

If one will inspect the formula for R_v postulating a one-turn winding and two bars covered by the brush, he will see that the only variables remaining are the capacity of the machine, the length of the armature and the total flux. Now the total flux is proportional to the diameter times the length, if the magnetic density is kept constant. Hence it reasonably follows that only a certain maximum capacity is possible for a given diameter. The value of the S_C is really more dependent upon the shape of the slots and, therefore, the above general reasoning properly applies. The limit just referred to is by no means reached by any of the particular dynamos in question and the theoretical corroboration will, therefore, be of interest.

There being 1,728 commutator segments in one of these machines, the number of bars covered by the brush is $2.21 = \sigma$. The output on full load is 2,500 kw. There being 48 poles, each having a pole flux of 7.3 mega lines, and the winding being a one-turn multiple, with a gross length of armature of 14.25 in., the value of R_v is 13.7:

$$R_v = 2.21 \times \frac{6.12}{100} \times 1 \times \frac{2{,}500}{48 \times 7.3} \times 14.25 = 13.7.$$

The slot dimensions are 1.3 in. by .58 in. If there are 18 slots per pole and the coil throw in slots is 17, the mutual induction factor is .5 and

$$\Sigma = \lambda_a + \frac{l_s}{i} \lambda_s = 1.16 + \frac{27.2}{14.25} \times .64 = 2.37.$$

Thus, the S_C follows by

$$S_C = \frac{13.7 \times 2.37}{12} = 2.7,$$

and if the current density in the brush is 34.3 amp. per sq. in., with a brush drop of 1.55 volts for this density, with Le Valle Vitæ brushes,

$$S_C = \frac{2.7}{1.55} = 1.74.$$

Thus, in this case the limit of 2 is not even reached. Therefore, the calculation indicates that the machine will carry its full load without sparking with the brushes in the neutral position. If the brushes are given a slight permanent lead forward, as is invariably done, then the generator will carry a 25 per cent overload without visible sparking and without spitting of brushes between no load and this value of overload. In the latter instance the $S_C = 1.93$, the $R_v = 17.1$, and the brush drop is 1.75 volts per brush. Although in this machine the copper drop of the short-circuited coil has little bearing on the sparking because the S_C is less than 2, it will be of interest to include the same:

$$W_t = \frac{1.575 \times 10^{-4} \times (12.25 + 27.2)}{.1 \times .4} = .00163 \text{ ohm.}$$

The copper drop of the short-circuited coil at the last instant will be, if the current per circuit is $\frac{8{,}333}{4.8} = 173$ amp., $173 \times .00163 = .282$ volt. The brush drop would be 1.55 volt, and thus

$$\frac{IW_t}{V} = \frac{.282}{1.55} = .182.$$

Progressive Work of the Janesville, Wis., Electric Company.

Janesville, Wis., a town of 13,770 population, located on the Rock River in southern Wisconsin, is supplied with electric light and power by the Janesville Electric Company from three generating plants.* The principal or central plant is in the center of town and is a combined steam and water power plant. Just below Janesville at Monterey is a water power plant with steam reserve, and 12 miles above Janesville is a small water power plant supplying current over a 6,600-volt transmission line. There is enough water power to carry the load except occasionally at the peak, when the steam plant at the central station is started. The steam plant at Monterey is kept only for use in case of a breakdown of some other part of the generating system. The boilers are kept empty and the packing removed from the engines, but the plant can be started on a few hours' notice. A pump belted to the water wheel shaft is used for filling the boilers.

DEVELOPMENT OF SMALL FACTORIES.

In the paper read before the recent Northwestern Electrical Association at Chicago on "Suggestions for Increasing the Power Output of Central Stations," Mr. P. H. Korst, manager of the Janesville plant, dwelt upon the cheap supply of electrical energy for small manufacturing enterprises as an important factor in the growth of a town. Mr. Korst's own city, Janesville, is a good example of this, as it is a town having a large number of small factories. One thing which has influenced the location of some of these factories in Janesville is the cheap power supply. Mr. Korst in building up this plant has realized that with water to carry the day power load, he could afford to make a very reasonable rate. He has further realized that by advertising the advantages of Janesville as an electric power center, he would secure the co-operation of the Janesville press and public and incidentally advertise central station service for all purposes. As a result of its effort in this direction the company has connected about 400 motors with an aggregate capacity of 700 horse-power.

RATES.

The rate for power is 5 cents per kw-hour. For each motor of 1-hp and less rated capacity, a minimum charge of $1.25 per month is made, and for each motor of over 2-hp a minimum charge of $1.00 per month per hp or fraction thereof.

Energy used for incandescent lighting and low-tension arc lamps is sold at 10 cents per kw-hour. The minimum bill for incandescent lighting is $1 per month and $2 per month for each enclosed arc lamp. On all bills 5 per cent discount is allowed for payment within 12 days. Discounts on lighting and power bills according to quantity used are made as follows:

Bills of	from $5.00	to $10.00	per month,	5	per	cent	discount.
	$10.00	to $20.00	" "	10	"	"	"
	$20.00	to $30.00	" "	15	"	"	"
	$30.00	to $40.00	" "	20	"	"	"
	$40.00	to $50.00	" "	25	"	"	"
	$50.00	and over	" "	30	"	"	"

LAMP RENEWALS.

Free lamp renewals are furnished on regular clear bulb lamps of 10, 16, 20, 24 and 32-cp when the customers return the glass bulbs unbroken to the office of the company. Lamps accidentally broken, lost and not accounted for by customers, are charged to them at 20 cents for the 10, 16, 20 and 24-cp sizes and 30 cents for the 32-cp. Lamps other than the regular shaped

*A description in detail of the Janesville plant was given in the *Electrical World and Engineer*, dated Dec. 31, 1904.

clear bulb are charged extra as follows: Frosted, 5 cents each; dipper, 5 cents each; colored glass, blue, green or purple, 12 cents; colored glass, ruby or opal, 20 cents. Lamps for decorative or other special purposes are supplied to customers at approximately cost. The company uses lamps of 3.1 watt consumption.

FLAT RATE SIGN AND DISPLAY WORK.

The principal business street of the town shows that the company has been active in pushing the sign and display lighting business, and the books of the company show that there are connected the equivalent of 430 lamps of 16-cp on flat-rate sign contracts, and that the average consumption of energy is 3,300 kw-hours per month. There are 1,211 lamps of 2-cp in use on electric signs and 92 of 16-cp. In window and decorative lighting there are 57 lamps of 2-cp, 12 of 8-cp and 81 of 16-cp. There are 42 contracts on a flat rate for this class of lighting. The following table shows the rates per year for flat rate sign lighting:

1,852 hours, dusk at 11:00 P. M.		4,327 hours, dusk to dawn.
2 C.P.	$1.26	$2.11 per annum.
4 C.P.	2.52	4.22 " "
8 C.P.	4.73	7.89 " "
16 C.P.	8.47	14.73 " "

Where the company owns the sign 2/5 of the cost of the sign is added to the annual amount which lights come to as figured above, and a three-year contract is required. Ten per cent discount is given if the lamps are not on during peak in winter. All is subject to 5 per cent discount if paid by the 12th of the month.

CAPACITY AND LOAD.

The total connected load consists, besides the 700-hp in motors before mentioned, is the equivalent of 18,000 incandescent lamps of 16 cp, 150 low-potential arc lamps, 210 alternating-current street arc lamps and 25 incandescent street lamps of 50-cp. About one-quarter of the total incandescent and power load is alternating current. The balance is 110-220-volt direct current. The company supplies current for the operation of the street railway. It has some 500-volt generators in its central power station and can also connect two 250-volt, direct-current generators in series on the railway when necessary. The alternating-current generators in the central power station can be used either as motors or generators, being run as motors when power is being received from the other power stations and is needed in the shape of direct current. The total output for December, 1905, amounted to about 200,000 kw-hours at the switchboard. The direct-current peak on an ordinary day the last week in December, 1905, was 1,560 amperes at 110 volts. The afternoon of the same day the output was 700 amperes, most of which was power, which shows the importance of the power load in Janesville.

Three-phase alternating-current generators are employed. The street arc lamps are operated off of two phases of the three-phase bus-bars, the voltmeter being connected across this latter phase. The company has developed at its three plants water power to the amount of 1,100-hp and has a steam reserve of 750-hp, which is idle most of the time. The investment in water power plants is about $300,000, so that the interest charges are much higher than on a steam plant of similar capacity. Plans are now being made by D. C. and W. B. Jackson, of Madison, who are consulting engineers for the company, for the reconstruction of the lower plant at Monterey. The present hydraulic plant was formerly owned by a mill at that location.

ELECTRIC HEATING.

Good progress has been made in the introduction of electric flat irons for household and factory use. About 40 of these irons are in service and 25 heating pads. In order to get the flat iron business started, the company makes a standing offer to furnish customers with flat irons for 30 days free trial. A number of irons is constantly in use at the factory of a knitting company. The users took a dislike to these at first, but would not be without them now. In another factory, that of a clothing company, a 20-lb. iron and a 6-lb. iron are in use.

In one factory where electric flat irons have been introduced, it has been found that operators can do from 10 to 15 per cent more work than with gas-heated irons. These specific figures should be of considerable value to central station solicitors in pushing the electric flat iron business as well as to those writing advertising copy.

SPECIAL OFFERS.

The company made this year a special offer of 50 per cent reduction on all lighting bills for the first four months for any residence connected between January 1 and March 1. This has the effect of counteracting the lull in new business immediately after the holidays and getting customers connected before the advent of long hours of daylight in spring gets them out of the notion of electric light for the year.

A special effort is made to get residence business because Mr. Korst believes that when secured in large enough quantities it is even better than store lighting in a town where the stores close at 6 o'clock every evening. One way of securing residences as customers has been to get them to take a 16-cp porch light at a flat rate of 50 cents per month. After this is installed, the question of a hall light is taken up and then a meter is put in. It is only a question of time until the lighting of the whole residence is secured. Two large institutions having isolated plants are located in or near Janesville. In this case the isolated plants have proved a blessing in disguise, as the company is able to furnish service during the day time cheaper than the isolated plant, letting that take the undesirable peak load. At the county insane asylum the company furnishes lighting service entirely during the summer and pumps water, this pumping not being done during the peak. At the School for the Blind it furnishes day service, and is prepared to take the load if the isolated plant breaks down.

The wiring of customers' premises is not carried on as a business by the Janesville Electric Company. A separate company, the Janesville Contracting Company, of which Mr. Korst is the manager, undertakes this work.

The neutral wire on the secondaries of transformers and on the three-wire direct-current network is grounded as a safety precaution. The ground used is a galvanized-iron pipe 6 ft. long, which is driven into the ground and has a ground wire soldered to it.

ADVERTISING.

About $50 per month is spent on daily newspaper advertising. Soliciting is done by Manager Korst and two others who spend part of their time at this work. A contract has recently been made with the C. W. Lee Company, of Newark, N. J., for six months' service of the little bulletin entitled "Electric Service," published for the use of central station companies. This is mailed to customers. A number of other publications have been issued by the company. In December, 1904, when the company completed its new power plant, an illustrated description was printed in pamphlet form as an advertisement of the company's power service. Another booklet of a size for enclosure in an ordinary envelope has been published during the past year setting forth in general the advantages of electric service and giving a list of the motors installed in Janesville. Two pages are given to advice to owners of unwired houses in which it is shown that the wiring and installation of good electric light and fixtures in a house is a better investment than anything else that can be made around it. In the past four years the number of concerns using electric power in Janesville has tripled, while the number of residences illuminated by electricity has been quadrupled. Seven hundred meters are now installed, the net gain in the past year being 200.

One of the company's recent advertisements is given here because of its originality and the excellent way in which it covers the ground. It reads as follows:

"LIGHTCRAFT

means getting the best and most light for your money, so arranged that you get every possible advantage, such as artistic effect, the most light where needed and the least waste.

"EXPERT TREATMENT.

"Every situation needs a special treatment. We have experts in lightcraft who are at your service for the asking. Our

interests are identical with yours in getting results, results to you in the best illumination possible, to us in a satisfied customer who will get us others. Call, telephone or write to the Janesville Electric Company."

To carry on the business of the company, 17 persons are required. This does not include eight wiremen working for the Janesville Contracting Company on inside construction work for new customers. In the operation of the power plant four men are required at the central plant, two for each shift. At the Monterey plant there is one man for each shift. At the Fulton plant only one man is employed, but the plant is not operated 24 hours. Besides the station men there are four linemen, one trimmer, one meterman, one meter helper and one electrician. Two persons are employed in the office. An adding machine was recently put in the office on trial and found to be so useful that it was retained.

The company maintains a very attractive office and store room on the main street. This is open from 7 a. m. to 9 p. m. It is brilliantly lighted and has on display a large stock of electric fixtures and also motors and heating appliances.

PUBLIC HEATING DEMONSTRATION.

A public heating and cooking demonstration was held February 9 and 10 last, which excited much local interest. A recent letter from Mr. Korst as to this says:

"The results of our cooking demonstration were fairly satisfactory. We did not expect much in the way of immediate results, our idea being to show the people that when a house is wired for electricity the service need not be confined merely to lighting. The novelty of the demonstration also will cause ladies who visited it to chat about it and in this way the name of the company will be kept before the people. We sold six irons and have a good prospect for a complete electric kitchen. Much interest was shown in the other utensils and we will undoubtedly sell more later in the season. A demonstration of this kind would bring better results in the summer time because the people would then be more impressed by the absence of heat and would also be ready to begin immediate use. In the winter, many people keep their kitchen fire up with coal for the heating effect in the house as well as for cooking, and this makes it difficult to sell irons and cooking apparatus at this season."

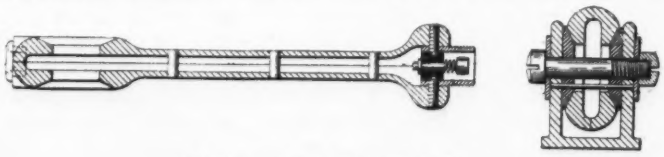
New Telephone Patents.

REPEATER CIRCUIT.

Mr. A. J. P. Bertschy, of Woodstock, Ill., has patented a repeating circuit for use when a successful repeater may have been found. In this circuit two repeaters are to be used at the repeating station, one effective each way. The diaphragm of each repeater is associated with a contact point in a manner such that the virtual resistance of the contact increases materially with the diaphragm in vibration. This contact controls the circuit of a shunting relay, the contacts of which shunt the other associated repeater. Thus, each repeater, through its shunting relay, may shunt out the other, according to which starts its vibration first.

TRANSMITTER ARM.

The accompanying illustration gives two sectional views of a new hollow transmitter arm patented by W. D. Gharky, of Phila-



GHARKY TRANSMITTER ARM.

delphia. It is designed particularly to fit that style of transmitter having integral connection lugs, as evidenced by the construction of the outer end. The hollow arm serves as a closed channel for the flexible cord, while the cone arrangement at the base renders clamping easy.

CIRCUIT PROTECTION.

E. A. Terpening, of Genesee, Ill., has found that receivers and induction coils legged to one side of a line and open at the switch hook contacts are subject to damage by lightning. To prevent this he advises the short-circuiting of these instruments, and to this end extra switch hook contacts are arranged to connect a short-circuit from the open point to the closed line whenever the receiver is on the hook.

INTERCOMMUNICATING SWITCH.

A self-releasing intercommunicating switch upon the push arrangement has been invented by A. G. Gilgen, of Passaic, N. J., his patent having been assigned to the New York Automatic Telephone Company. Locking bars which rotate upon longitudinal axes serve to unlatch and restore the pushes when the receiver hook is depressed. The return of the plug pushes to normal is accomplished by the back pressure of the contact springs. When a plug is depressed this contact spring rides up upon a portion so shaped that there is no tendency to return the push, there being merely a clamping action. When the hook is depressed, thus rotating the bars, these latter drive the plugs back until the restoring action of the springs begins.

STEP-BY-STEP SYSTEMS.

Three step-by-step party-line systems have recently been patented by Messrs. W. Palmer, Jr., of Rincon, New Mexico; P. T. Geyerman, of Brewster, Minn., and E. A. Buell, of De Kalb, Ill., respectively. These involve in various combinations the elements of their predecessors. While the adaptations are novel, there is nothing to indicate that these systems will accomplish more in practice than the earlier ones.

LETTER TO THE EDITORS.

High-Voltage, Direct-Current Railway Work.

To the Editors of Electrical World:

SIRS:—I note with interest Mr. Sprague's article on "The Reincarnation of an Electrical Idea" in the February 24 issue of the ELECTRICAL WORLD. There seems to be great interest and evident concern regarding the advantages arising from the use of auxiliary poles in direct, as well as alternating-current motors and generators, and engineers are beginning to appreciate the fact that more economic proportions of electrical machines may be obtained through the use of this expedient. This principle, although not new, has been only recently brought to a state of perfection which allows it to be commercially utilized, and some of the results which we have obtained by its practical application to our "inter-pole" motors have revolutionized, to some extent, the design of commutating machines, and Mr. Sprague's indorsement at the present time is greatly appreciated.

It is to be noted that although Mr. Sprague had the idea he states that he did not insert any actual polar projections. In one of our recent trade publications, from which Mr. Sprague quotes at length, we call attention to the sparkless operation of the "inter-pole" motors, under conditions which render the ordinary type uncommercial, as well as to the reduction in size and weight of these motors, compared with the ordinary type. More torque, per ampere per pound of material in our motors, is obtained than in any other type on the market to-day. This naturally suggests the utilization of the auxiliary pole feature in motors for service where space is limited, and no better instance of the desirability of making full use of this maximum torque per ampere is furnished than in the ordinary railway motor. By its use it is possible to obtain a flexibility and economy of operations in railway service far superior to that now furnished by the so-called "standard" direct-current equipment used almost exclusively to-day.

Although the article above referred to suggests certain advantages which may rise from the use of this type for railway equipments, the author does not indicate any definite methods by which these results are to be obtained. It might be of interest to you, and to railway engineers at large, to know that we have developed and protected our "inter-pole" motor and controller systems along these lines to such a degree that we are able to

state that without any more energy consumption than that required by the "standard" equipments they will give a considerable increase in the schedule speeds of existing railroads, or render it possible to retain present schedules at a lower energy consumption, and, therefore, enabling more to be operated from existing railway plants or the same number of cars at less expense.

Some idea of the enormous flexibility of our motors may be gained when we consider that the standard 500-volt types may be successfully operated on voltages up to 1,000 volts, and that they stand tests of 100 per cent overload in fields of only 10 per cent of the ampere-turns or normal rating absolutely without sparking. This at once suggests control systems vastly superior to any at present in commercial operation, giving almost an unlimited number of efficient running speeds as well as making it possible to operate on voltages never before attempted in direct-current railway work, even up to 2,000 volts. Also the advantages of using low voltages in cities and high voltages outside can be secured without the complications of carrying two sets of controlling apparatus on the same car, as is now done on the alternating-current-direct-current systems and the saving in the cost of feeders and the elimination of many sub-stations would be the direct result of thus being able to operate with the same motor on higher direct-current voltages. That is, on the main line, we could use 1,500 or 2,000 volts, but on branch lines or in towns or cities, the same motors could be operated on 500 volts with high efficiencies.

We are pleased to note that such an eminent authority as the author of the article referred to above has called attention to this basic principle upon which all of our motors have been designed and which we were the first to place on a commercial basis. It is wonderful to note what an intuitive grasp of the possibility of motor development Mr. Sprague had even in the early days, and that his predictions of the future of this type of motor in railway work have already been proven by our own experience.

Bayonne, N. J. The Electro-Dynamic Company,
Per G. H. Condict.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Starting of Single-Phase Commutator Motors.—Richter.—A discussion of the difficulties which single-phase commutator-motors offer during the starting operation. The author discusses the inherent difficulties and illustrates his theoretical explanation by results obtained in the testing department of the Siemens-Schuckert Works. The discussion is not intended to be exhaustive but only to explain the main difficulties and to show to what extent they may be obviated by different remedies. In all commutator-motors which have become of practical importance, windings of the armature are short-circuited by the brushes, while at the same time a magnetic flux—in general the excitation flux—passes through them. This flux produces an e.m.f. in the short-circuited coil, the e.m.f. being directly proportional to the frequency of the alternating current. This "e.m.f. at rest" can be obliterated by an opposing e.m.f. "of motion" if the armature revolves and if in the motor a "cross field" of proper intensity and phase is produced (as for instance in the repulsion motor). On the other hand, there does not exist so far any means of obliterating the obnoxious "e.m.f. at rest" while the rotor is at rest or during the starting operation. This e.m.f. in the short-circuited coil produces a current which increases the losses of the motor, especially at the commutator, and which causes sparking at the brushes and makes the starting of the motor most difficult. The author points out that just at starting the alternating-current commutator-motor is much inferior to the direct-current motor. He shows from actual experimental results that in starting the same power may be consumed as at full-load even if the losses in the starting transformer are not at all considered. If the latter would be considered it would be found that the total losses in starting with alternating-current and a starting transformer are even greater than in starting with direct current and ohmic resistances. The author discusses at some length the different remedies which have been suggested. The short-circuit currents in the armature coils short-circuited by the brushes make the starting operation difficult in two respects. First they produce a phase difference between the armature current and the flux and thereby increase the motor current; second, they increase the current passing through the brushes, heat the commutator, and increase the losses. Partial remedies to overcome the first disadvantage are the use of hard and thin carbon brushes, the increase of the reluctance of the magnetic circuit, the use of separate brush sets and in certain cases the employment of an induction coil in shunt with the excitation winding; but a complete remedy may be obtained only by using resistances inserted between winding and commutator. All these remedies have disadvantages. The use of thin brushes may lead to interruption of service since the hard carbons are brittle and break easily—which will happen, for instance, if the wear and tear of insulation and copper is not the same. Further, there is an increase of the friction losses of the brushes since the pressure per unit of surface must be greater with thin brushes than with thick ones. An increase of the reluctance of the magnetic circuit increases the excitation voltage and the copper weight of the motor, also perhaps the iron losses. The use of separate sets of brushes requires a transformer and is effective only with very narrow brushes. A shunt-connected induction coil offers only small advantages if the stray field between excitation winding and short-circuited armature coil is large. Resistances between winding and commutator can be placed in the motor only with difficulty if they are chosen so large as to be effective. To overcome the second disadvantage mentioned above—namely the increase of losses—there is really only one remedy, that is, the use of resistances between winding and commutator.—*Elek. Zeit.*, February 15.

Voltage Regulation of Alternators.—Legros.—A mathematical paper on the calculation of the rheostats for the regulation of the voltage of alternators by either of the following two methods: In the first method a rheostat is connected in series with the shunt-winding of the exciter; in the second method it is connected in series with the excitation of the alternator in the main circuit of the exciter.—*L'Eclairage Elec.*, February 10, 17.

Direct-Current Dynamo Construction.—Jordan.—An article illustrated by a great many diagrams describing in detail the winding of a typical direct-current armature.—*Elec. Jour.*, January.—The physical and other qualities demanded by the commutator and some details of commutator construction are discussed in *Elec. Jour.*, February.

Lights and Lighting.

Train Lighting.—Valbreuze.—An illustrated description of the following systems of electric train lighting: Pieper-L'Hoest, Boese, Denhan, Siemens-Schuckert, Leitner-Lucas.—*L'Eclairage Elec.*, Feb. 10. The last named system is also described with illustrations in Lond. *Eng'ing*, February 16.

Power.

Large Motors for Reversing Mills.—A note stating that the Allg. Elek. Ges., of Berlin, is at present engaged in equipping the rolling mills of the Hildegardenhütte in Teschen with electric motors having a maximum output of 10,000 hp and some rolling mills belonging to the State Railroads at Budapest with 12,000-hp motors. The same firm is also providing the electric drive for the reversing mills of the Rombach iron works. These reversing rolling mills are to be directly driven by two 6,500-hp motors, and during the first part of the rolling operation the motors have to reverse six or seven times in a minute.—Lond. *Elec.*, February 16.

Induction in Transmission Circuits.—Scott.—An illustrated lecture giving an elementary consideration of the physical basis

underlying self-induction and mutual induction in transmission circuits.—*Elec. Jour.*, February.

Traction.

Comparison Between Single-Phase and Three-Phase Equipment.—DE MURALT AND ARNOLD.—In an article of de Muralt the author takes the case of the Sarnia tunnel of the Grand Trunk Railway and analyzes the difference in cost of operation and efficiency of the service if three-phase motors should be used instead of single-phase. The author claims that by using the three-phase system there would be a saving in the first cost of installation, amounting to at least $100,000 out of a total of $500,000. In comparing the cost of operation, he estimates that 28 per cent of the cost of energy could be saved, mainly on account of recuperation of energy. B. J. Arnold, consulting engineer of the Grand Trunk Railway for this installation, replies to the article. He fully recognizes that there are conditions under which the three-phase system can show advantages so far as economy of operation is concerned, but in deciding upon the type of apparatus to adopt for a given installation there are many things to be taken into consideration aside from operating efficiency. Not the least of these are: First cost of installation, the commercial availability of the apparatus and convenient access to the manufacturer furnishing it. These three points will generally govern where the difference in efficiency of operation between systems is small. Regarding the first cost of single-phase and three-phase installation he states that while he has been led to believe that three-phase railroad equipment could be purchased for about the same cost as direct-current equipment, and therefore for less than single-phase equipment, when bids were asked for an installation of considerable magnitude upon a road with which he is connected, the tenders for the three-phase installation taken as a whole were much higher than those of either the direct-current or single-phase installations. He presumes, however, that if three-phase apparatus was manufactured in this country, this condition would not hold.—*St. R'y Jour.*, February 17.

Heavy Electric Traction.—SHEPARD.—A note on some features of heavy electric traction. In steam railway operation the economical movement of traffic is in large volume, that is, by long and heavy trains. The principal limits to development in this direction are found in the steam locomotive. The length of its rigid wheel base, the maximum weight on a pair of drivers and the steaming capacity cannot be materially increased. The electric locomotive operated from a high voltage trolley possesses certain fundamental features which adapt it to overcome these limitations. The high voltage trolley with sub-stations widely separated so reduces the cost of the transmission system that it it is no longer imperative to keep the load upon the system in small distributed units. The multiple control system overcomes the limitations of rigid wheel base and the weight on drivers of the steam locomotive. The horse-power which can be applied to the drawing of a train by locomotives is limited by the boiler capacity, but in the electric system it has no corresponding limit, as all trains receive their power from a large power plant. Instead of supplying one thousand horse-power to each of two trains running ten miles per hour an electric power house can supply two thousand horse-power to a single train at twenty miles per hour with equal facility, thereby reducing the number of train-hours for the handling of a given traffic.—*Elec. Jour.*, February.

Gas Power in Railway Plants.—BIBBINS.—A long illustrated article on gas power in the operation of high-speed interurban railways, from the experience on the Warren and Jamestown railway system. The results obtained are very satisfactory.—*Eng'ing Record*, February 17.

French High-Speed Electric Parcel Post.—As was already briefly noticed in the Digest, a French company called "Société des Chemins de Fer Electro-Postaux," has recently carried out successful trials on a circular and experimental high-speed electric parcel railway on a route 1 km. (0.62 mile) in diameter. The experimental parcel trolley car appears to have been 25 ft. long with pointed ends, and its cross-section 1 metre (3 ft. 3⅓ in.) square. This car was suspended from the track rail by two running wheels and guided by two pairs of side rollers. Each running wheel is belt-driven from a three-phase motor, 31½ in. in diameter. The current was collected by means of three collectors of the bow type. It is proposed to build such parcel posts between large cities, with two tracks (one for either direction of traffic), built one above the other in an underground tunnel of elliptical shape. It is not stated what speed was attained in the trials, but the promoters seem confident that a speed of 155 miles per hour can be safely maintained in practice with parcel trolleys carrying a useful load of 10 cwt.—Lond. *Elec.*, February 16.

Electric Railway Engineering.—The conclusion of the long discussion which followed the paper of Carter which was recently abstracted in the Digest. A majority of the speakers expressed themselves in favor of single-phase, while Carter maintained the position taken in his paper that with a severe suburban service the single-phase system could not hold its own against the direct-current system. He did not deny the necessity for using single-phase for main line working. Hobart advocated high-tension direct-current motors. He thought that "a fraction of the expenditure in developing the single-phase motor up to its present stage—which was considerably wanting when subjected to direct comparison—would have produced a highly satisfactory continuous-current high-voltage motor, and he trusted that manufacturers would give this their consideration."—Lond. *Elec.*, February 16.

Electric Railway Engineering.—The first part of a serial on electric railway engineering based on a course of lectures by Renshaw. The first paper by Wynne deals with general principles relating to the operation of cars or trains, the second paper by Webster to motor construction.—*Elec. Jour.*, January and February.

Overhead Equipment.—See the abstract under Wires, Wiring and Conduits.

Installations, Systems and Appliances.

British Central Station.—An illustrated description of the municipal central station of Mansfield, which is worked in conjunction with a refuse destructor treating 200 tons or so of refuse per week. There are three 240-kw compound-wound generators; their voltage is 480 to 600, being suited for either lighting or traction purposes. The latest one of the three generators installed has interpoles or commutation poles, and this is said to be the first application of this principle in British central station practice. The equivalent 8-cp lamp connections at the present time amount to 25,000, and for the street lighting 40 Gilbert arc and 14 ¼-ampere Nernst lamps are in use. The tramway consists of some 10 miles of route.—Lond. *Elec., Rev.*, February 16.

Heating and Lighting Plant.—GRAY—An illustrated description of the central heat, light and power plant of Bryn Mawr college. Electric distribution is on the direct-current, three-wire system with 250 volts between the outers.—*Eng'ing Record*, February 17.

Wires, Wiring and Conduits.

Overhead Equipment.—TWEEDY AND DUDGEON.—The first part of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. on the construction and maintenance of overhead equipment. The authors first speak of pole construction. "If engineers could persuade themselves that 18 in. sag in a 30-ft. span and 2 ft. across a 40-ft. road is neither unsightly nor detrimental, and would insist that the span wires are not pulled up any more than that, they would find the light poles which they have cast aside strong enough for 75 per cent of the construction, allowing heavier poles for curves and the like on 25 per cent of the line." When poles are subjected to less strain the quality of the concrete setting may also be reduced. Cast-iron bases are considered a luxury; if they are not to be given up, they should at least be drained and ventilated. The question of ventilation applies with almost greater force to the poles. "Another luxury, for which there is no more excuse than the base, and to which the objections are even stronger, is the cast-iron collar which conceals the joints in sectional poles." The authors then briefly discuss section pillars, span wires, bridle and pull-off wires, guard wires and hangers. Malleable iron hangers have the advantage over those made of bronze that no local

The authors mention the following incidents: "On the whole of one route, 5½ miles long, the hangers are of bronze; on another route, 4 miles in length, and a branch of the first, they are of galvanized malleable iron. While the span wires where they clasp the bronze hangers, are practically eaten through and have broken in several cases, the galvanizing of the span wires under the malleable iron hangers and on the hangers themselves is as good as it was when put up. That is conclusive evidence that the decay of the first span wires was not caused by rust. The same action occurs wherever the span wire is attached to secondary insulators in which the eyes are of brass." In discussing insulators the authors emphasize that electrolysis is the main factor concerned in the destruction of both iron and brass bolts. To obviate the troublesome failures of this kind they think that "entire prevention can be obtained by the insertion of a shield between the trolley-wire ear and the hanger, in order to keep the bolt dry. The trolley wheels cannot then throw water into the interior of the hanger, and neither rust nor electrolysis can corrupt. Secondly, the form of the hanger may be altered, making it nothing more than a metallic link between the ear and the span wire, and providing for insulation by means of two (three per span) external and independent insulators. Lastly, the hanger may be composed of homogeneous insulation, such as glazed porcelain, something in the shape of a cable sealing-end, through the center of which a plain metal bolt is passed. Whatever form the primary insulator takes it must be kept dry, or leakage and carriage of metal will start. Therefore, this porcelain insulator should be provided with a hood of some light material to guard it against rain, and with the shield mentioned above to prevent access of moisture from the trolley wheels." The authors then discussed secondary insulators and the leakage and electrolysis across them. The paper is to be concluded.—Lond. *Elec.*, February 16.

Slide Rule.—Roberts.—An article describing a method of making a simple slide rule for wiring calculations.—*Elec. Jour.*, February.

Electrophysics and Magnetism.

Coupled Oscillators.—Fischer.—If two condenser circuits or other electric oscillators of the same frequency are not coupled extremely loosely, two oscillations of different frequency and damping are generated in each circuit. If, in accordance with the Hertz-Bjerknes method, these two oscillations are made to act upon a condenser circuit of variable frequency, resonance curves with two maxima are obtained. The frequencies and decrements are easily measured by that method if the circuits are fairly closely coupled, since in that case the two maxima are separated by a region of zero resonance. But when the coupling is loosened, the two maxima gradually coalesce, and the Bjerknes method can no longer be employed. For this case the author has worked out a new method proposed by Zenneck, by means of which each of the two maxima can be studied separately on Bjerknes' principle. It is essential that the oscillations of the same frequency in the two systems shall have nearly the same phase, or else differ by 180 deg. The arrangement is shown in Fig. 1, where *I* and *II* are the oscillators, *B* a bolometer, *C* a variable condenser, and *M* the measuring circuit. If 4 is coupled with 2, and the measuring circuit is brought into resonance with one of the oscillations, then on adjusting the coupling of 1 and 3 to a minimum, the only maximum shown is that of the other oscillation.—Lond. *Elec.*, Feb. 16; from *Ann. d. Phys.*, No. 1, 1906.

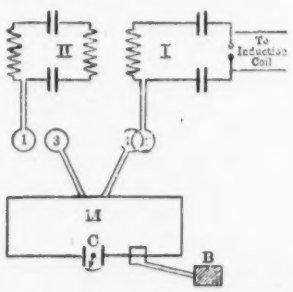


FIG. 1.—COUPLED OSCILLATOR.

Alpha Rays—Rutherford.—A second paper on some properties of the alpha rays from radium. The points brought out in this paper are summed up as follows: The rays from radium in radioactive equilibrium are complex and consist of alpha particles projected with different velocities. The alpha particles decrease in velocity in their passage through air and through aluminum. The absence of increased deflection of the rays from a thick layer of radium after passing through aluminum, observed by Becquerel, is a necessary consequence of the complexity of the rays. The decreasing curvature of the path of the rays in air, observed by Becquerel, is also a necessary consequence of the complexity of the rays. There is evidence of a distinct scattering of the rays from radium C in their passage through air.—*Phil. Mag.*, January.

Absorption of Alpha Rays.—McClung.—An investigation of the absorption of the alpha rays from radium by matter. The author used as the source of the alpha radiation the radioactive matter deposited on a wire which had been suspended in a vessel containing the emanation from radium. His results are in accordance with former measurements of Bragg and Kleeman. The author studied the absorption of alpha rays by air and aluminum. One layer of aluminum 0.00031 cm. in thickness absorbs as much alpha radiation as 0.5 cm. of air. The agreement between several of his results points strongly to the conclusion that the ionizing, photographic, and phosphorescent effects of the alpha rays from radium are all due to the same cause, and that it is very probable that in each case the effect produced is primarily one of ionization.—*Phil. Mag.*, January.

Rate of Decay of Radioactivity.—Bronson.—An account of an experimental investigation of the effect of high temperatures on the rate of decay of the active deposit from radium. The main results are as follows: Temperatures between 700° and 1,100° C. do not permanently affect the rate of decay of the active deposit from radium. Radium *B*, and not radium *C*, has the longer decay period. The previous values of twenty-eight and twenty-one minutes are too large for the decay periods of radium *B* and *C* respectively, and twenty-six and nineteen minutes are much closer to the true values.—*Phil. Mag.*, January.

Uranium.—McCoy.—An account of an experimental investigation of the relation between the radioactivity and the composition of uranium compounds. Radium is between 3.3 x 10^6 and 4.25 x 10^6 times as active as uranium.—*Phil. Mag.*, January.

Constitution of Atom.—Lord Rayleigh.—A mathematical paper on electrical vibrations and the constitution of the atom. The author refers to Thomson's view of an atom being composed of a large, but finite number of negative electrons within a sphere of positive electrification, and investigates what becomes of the theory when the number of electrons becomes infinite. He makes some critical remarks on the application of Thomson's views to the explanation of spectrum analysis. The issue also contains a paper by the same author on the constitution of natural radiation with reference to a recent publication by Larmor.—*Phil. Mag.*, January.

Units, Measurements and Instruments.

Iron Core Alternating-Current Instruments.—Sumpner.—A description of various new kinds of alternating-current instruments, in which the author endeavored to imitate the model of the permanent-magnet moving-coil instrument for direct-current circuits. The instruments, which comprise ammeters, voltmeters and wattmeters, are characterized by having a moving-coil circuit and a fixed electromagnet. An electromagnet introduces in general errors of two kinds; the magnetism produced may differ from what is required in its amount or in its phase and wave form. These points are discussed and four diagrams are then given (Figs. 2 to 5) which show how the instrument may be

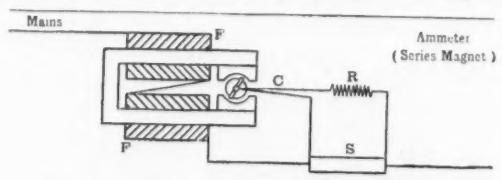


FIG. 2.—ALTERNATING-CURRENT AMMETER.

connected to the circuit for the various purposes of an ammeter, a wattmeter or a voltmeter. The instrument has two circuits, each of which may be connected with the mains in series or in shunt. There are thus four cases to consider. Figs. 2 and 3

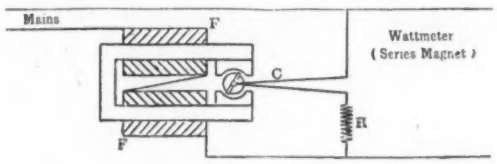


FIG. 3.—ALTERNATING-CURRENT WATTMETER.

represent the ammeter and wattmeter, each with a series-wound electromagnet. Figs. 4 and 5 represent shunt magnet instruments, the former denoting a voltmeter, and the latter a wattmeter. In Fig. 4 the moving coil, *C*, is put across the mains in series with a condenser, *K*. In Fig. 5 the moving coil, *C*, forms part of a

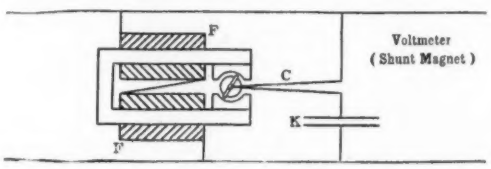


FIG. 4.—ALTERNATING-CURRENT VOLTMETER.

circuit including a large non-inductive resistance, *R*, and the secondary, *S*, of a small transformer whose primary *P*, is traversed by the main current. This transformer must have a magnetic circuit of constant reluctance. In both of these cases the moving coil current is in quadrature with the electrical quantity produc-

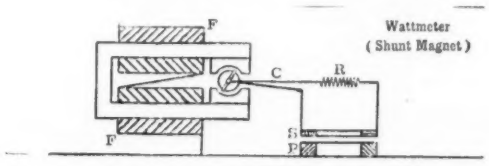


FIG. 5.—ALTERNATING-CURRENT WATTMETER.

ing it. Thus in Fig. 4 it is proportional to the rate of change of the voltage, while in Fig. 5 it is proportional to the rate of change of the current. The reason for securing the quadrature relationship is to be found in the action of the electromagnet when excited by the voltage of the mains. With a magnet of good design the induced voltage in the windings due to the changing magnetism in the iron will be so large compared with the copper drop that the former will not appreciably differ from the voltage of the mains. The magnet flux, *F*, and the line voltage, *V*, will be in quadrature, since *V* will be proportional to the rate of change of *F*. The moving coil current, *C*, will be caused by *Q*, the second electrical quantity affecting the instrument. In Fig. 4 *Q* is the line voltage *V*, while in Fig. 5 *Q* is the load current *A*. Thus the average product of *VQ* is either the square of the voltage for Fig. 4 or the power in watts for Fig. 4. The deflection of the instrument is dependent on the average product of *CF*. Now it can be proved mathematically that whatever the frequency or wave form, the mean value of *VQ* is proportional to the mean value of *CF*, provided exact quadrature relationships are obtained—that is, if *V* varies as the rate of change of *F*, and if *C* varies as the rate of change of *Q*. Under these circumstances the deflection of the instrument will measure either the voltage or the watts if the instrument connections are those of Fig. 4 or Fig. 5 respectively. The shunt magnet has a striking property most valuable for instrument purposes. Its magnetism is determined by the voltage, and variations in the permeability of the core do not alter the ratio between the two. If the voltage doubles the magnetism must also double, whether the permeability varies or remains constant. This is strictly correct only if the resistance of the winding is zero. The author points out that the characteristics of the electromagnet when excited by a series or shunt winding form a striking contrast and explains why for an ammeter the series magnet must be used. —Lond. *Elec.*, February 2.

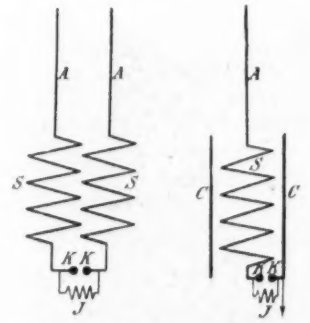
Series Transformers for Wattmeters.—WILD.—Alternating-current wattmeters and ammeters when used with currents above 100 or 200 amperes are generally worked with series transformers. The main object is to avoid the large errors due to the effect of eddy currents that occur when a conductor of large section is brought into the instrument itself. The use of the series transformer may also introduce serious errors unless it is carefully designed. In order that accurate results may be obtained it is necessary that the current ratio of the transformers be as nearly as possible equal to the winding ratio, and also the phase difference between primary and secondary currents as small as possible. This result must be obtained by reducing the core loss and magnetizing currents to a minimum and by paying very careful attention to the question of magnetic leakage. A design of transformer adopted by the author is described in detail. Incidentally the author mentions some determinations of core loss which bring out rather an interesting fact not hitherto published—namely, that between values of Bmax of from 200 to 400 the core loss reckoned in watts increases as about the 2.7th power of Bmax, which contravenes the Steinmetz law (or rule), and is quite different from results commonly obtained at ordinary transformer iron at maximum densities of 2,000 to 8,000.—Lond. *Elec.*, February 16.

Resolving a Periodic Wave Into Its Harmonics.—A mathematical paper by Lyle on an expeditious practical method of harmonic analysis in *Phil. Mag.*, January.—An article illustrated by diagrams on a graphical method of harmonic analysis by Harrison in Lond. *Eng'ing*, February 16.

Phase Meter.—SUMPNER.—His full paper on the mathematical theory of phase meters, an abstract of which has been noticed in the Digest.—*Phil. Mag.*, January.

Telegraphy, Telephony and Signals.

Resonator for Wireless Telegraphy.—KOEPSEL.—The closed oscillation circuit adopted first by Braun and later by others has a great advantage over the original Marconi sender, since it permits a considerable increase of the energy of the system, on account of a greater capacity. The author has endeavored to design an open resonator of large capacity. A successful open renonator would be much simpler in operation and would not require as careful tuning as the closed type adjustment. The resonator of the author is shown in Fig. 6, in which the vertical



FIGS. 6 AND 7.—RESONATORS.

wires, *AA*, before they are connected with the spark-gap, *KK*, are wound in coil form, whereby the coils may be placed either side by side or may be wound one above the other. By changing the distance of the two coils it is possible to increase the capacity of the system at will while the self-induction of the same (which is identical with the mutual induction if the system is considered as a whole) may be diminished at will down to a practical limit. By changing the distance between the two coils it is therefore possible to adjust the self-induction and capacity. Nevertheless the system—like the ordinary open resonator—will always remain in resonance. The number of windings of the two coils may of course be chosen at will. For instance one coil may consist of many windings, the other of only one. If the latter is earthed the arrangement shown in Fig. 7 is obtained which consists of a coil, *S*, connected to the vertical wire, *A*, the coil, *S*, being surrounded by an earthed cylinder, *C*. This open resonator has the advantage that the tuning process is much easier so that, with one and the same vertical wire, different

wave lengths may be transmitted or received. The author discusses in a general way the advantages of the system, but it does not seem that he has yet tested it by experiments.—*Elek. Zeit.*, February 15.

Automatic Circuit Breakers.

The accompanying illustrations show the type C line of automatic circuit-breakers which have been developed by the British Thomson-Houston Company. A form G breaker is indicated in

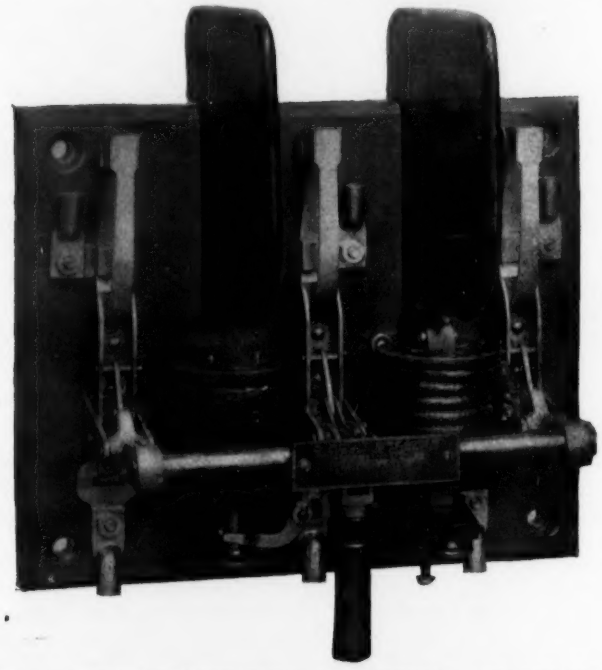


FIG. 1.—CIRCUIT-BREAKER WITH ONE OVERLOAD AND ONE LOW-VOLTAGE COIL.

Fig. 1. This circuit-breaker is provided with a toggle joint, which makes the action quick and positive. The main contacts are of laminated copper, and the secondary or arcing contacts are of

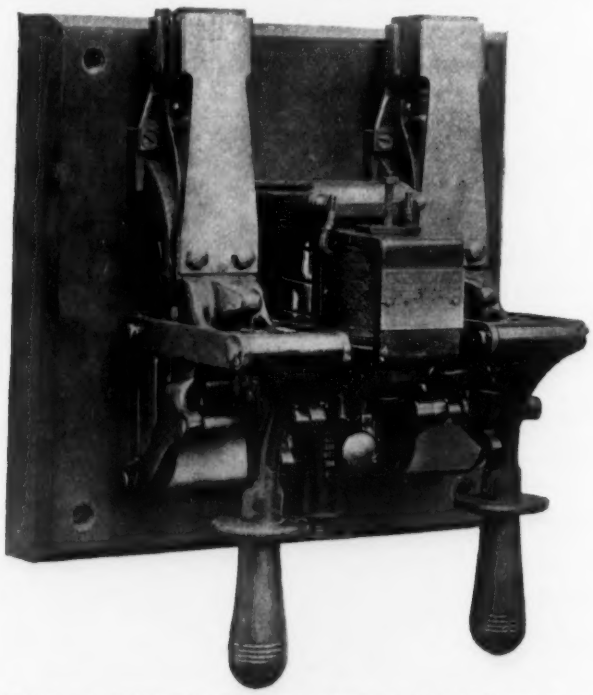


FIG. 2.—CIRCUIT-BREAKER WITH LOW-VOLTAGE ATTACHMENT.

carbon, which can be easily removed. This form of breaker is intended for use with either direct or alternating-current circuits.

In the form P breaker, one model of which is shown in Fig. 2, three distinct contacts are employed, the main contact, the auxiliary copper contact and the auxiliary carbon contact. These are arranged one above the other in the direction in which the arc naturally tends to travel, thus removing the danger of transfer of the arc on to the main contacts owing to draughts. A quick break is secured without the aid of any auxiliary springs, and the trip is of the gravity type, being also independent of springs.

A form K is shown in Fig. 3. These breakers are especially designed for the heaviest service. All movements are in a vertical edgewise plane, and all parts are so arranged as to allow a number of circuit-breakers to be mounted in line on short centers with maximum clearance. The main current carrying parts

FIG. 3.—6,000-AMP. CIRCUIT-BREAKER.

consist of two studs through which the current is led from the back of the board into the working parts at the front. The copper laminations are forced into contact by a toggle mechanism giving high pressure at the end of the stroke with minimum effort of the operator and minimum load on the trip or catch. The spreading of the laminations gives a powerful spring action which promptly throws the moving parts to the open position when the circuit-breaker is tripped from the catch. The opening action is completed by gravity, no auxiliary springs being required.

The American agent for these breakers is the General Electric Company, Schenectady, N. Y.

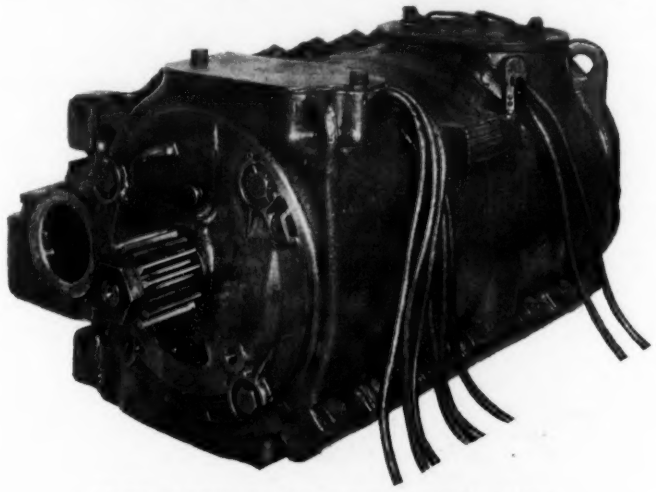
Single-Phase Road for Milwaukee, Wis.

The Milwaukee, Wis., Electric Railway & Light Company has made a contract with the General Electric Company for single-phase equipment to be placed on two of its longer suburban lines. One of these lines will extend from Waukesha to Oconomowoc, a distance of twenty miles, and the second will operate between Hale's Corners and Mukwonago, a distance of sixteen miles. Both lines will be operated at a potential of 3,300 volts, and in addition the motors are designed to run on the existing seven miles of 550-volt direct trolley line between West Allis and Milwaukee.

The motors to be furnished for this equipment are the standard General Electric alternating type, shown in the illustration. Each of the ten cars comprising the initial equipment for the road will be furnished with four motors of 75 hp each. These are of the compensated type, comprising an armature similar to the ordinary standard direct-current, bar-wound form, with mica insulated coils. The motor fields consist of laminated pole pieces over which are slipped the spools of the exciting winding; the compensating winding consists of a bar winding inserted in the pole faces and permanently connected in series with the

armature winding. The 75-hp motor is wound for four poles and has a maximum speed of about 1,400 r.p.m.

These equipments will in general be operated as single cars, but occasionally will be run in two-car trains. For the flexible control of these train combinations the Sprague-General Electric system of multiple unit control will be used, adapted for operation on alternating current. The compensator for use in these cars is of the oil-cooled type, and is wound for 3,300 volts on the primary, with five different secondary taps for controlling the speed of the motor. In order that the acceleration may be smooth special devices are employed so that there will be no break in the circuit from one tap to the next during a change in speed.



75-HP ALTERNATING-CURRENT RAILWAY MOTOR.

The speed regulation is so devised that the running speed will be the same on both the alternating and direct-current portions of the line.

Distribution to the various transformer sub-stations on this line will be at 33,000 volts. At the stations the current will be fed to the trolley line at 3,300 volts. For this latter the General Electric catenary construction will be used. It is proposed to have this line in operation during the fall of 1906.

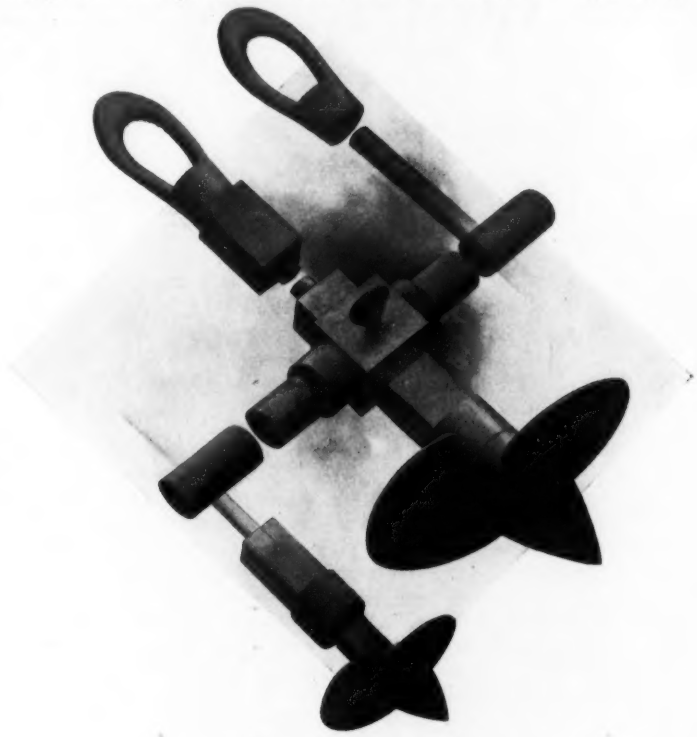
Guy Anchors for Electric Poles.

A number of material improvements have been made in the Stombaugh guy anchor, the patents of which are owned by W. N. Matthews & Brother, 227 North Second Street, St. Louis. A new type is herewith shown. The 5 and 6-in. anchors are now made with a square shank of equal size permitting the use of the same wrench for both anchors, whereas formerly separate wrenches were necessary.

In the past, considerable trouble has been caused the users of the 5 and 6-in. anchors by defective welds in the rods and eyes. A full rod is now used with no welds. The eye is drop-forged and threaded to the rod. A much larger eye is thus permissible and the eyes are now made amply large to accommodate standard guy thimbles. This eye is made smooth and of such shape as to do away with the absolute need of the thimble.

The hollow shaft is made of seamless square tubing of much greater torsional strength than the old style round tube. It is further reinforced by a malleable iron square key that fits the square shanks of the anchors. This key is brazed on. The handles are attached to a sliding cross that is held at any point on the shaft by means of a non-removable set-screw. This sliding cross is a great convenience when screwing the anchor into the ground, as the maximum amount of leverage can always be had at all stages of the installation.

In installing the anchor, the hollow shaft is slipped over the rod after removing the eye. It is keyed firmly to the square shank of the helix, and the eye is then replaced on the end of the rod. The eye will serve to hold the wrench firmly in place during installation. The handles are then slid down the shaft to a convenient point, and then the anchor is screwed in until the handles get too close to the ground for further manipulation. The set screw is now loosened and the handles are slid back again to a more convenient position for work, when the process is repeated as before until the anchor is driven in to the required depth. The eye is then removed, the wrench pulled out, the eye replaced, the guy strand is attached, and the pole is anchored securely in a period not exceeding 15 or 20 minutes.



STOMBAUGH GUY ANCHORS.

The Hatch Storage Battery.

The new Hatch accumulator, as such it might be termed, although it gave most satisfactory practical results wherever installed, has been improved upon and carried to a greater degree of perfection within the past year. The capital of the company has been increased to allow for extending its plant and the handling of some very large contracts for which its old facilities were entirely inadequate.

The battery has been described previously in our columns and its general features are well known. The positives are enclosed in a porous stiff pottery envelope and do not deteriorate by the falling away of the active material, while there is no accumulation of mud in the base of the cell. At the same time the negatives are directly exposed to the electrolyte, thus providing for the free escape of the gases generated at the negative. The entire surface of all the Hatch metallic electrodes is covered by the active material, and no current can pass without going through the active material. The exposure to the electrolyte is the maximum, and hence the internal resistance is correspondingly reduced to the lowest point.

Moreover the introduction of the porous diaphragm breaks up the bubbles in the electrolyte, and equalizes the flow of gases on charge, so that at no time are the fumes annoying, nor do the containing jars become covered with the spray of the solution, while in the use of wooden lead-lined boxes they never become saturated, it is said, as in the case of batteries of the open grid type. There is, moreover, freedom from the difficulties of rapid disintegration, due to discharge at high rates, or from the giving up of the oxygen from the positive plate, when the minute explosions in the mass of the active material tend to break it up gradually and to slough off the loosened particles. The Hatch accumulator, it is stated, does not from such a cause lose its original capacity or short-circuit through the sludge in the bottom of the cell. The Hatch Accumulator Company has its headquarters at 60 State Street, Boston.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions are favorable and country buyers are making liberal purchases. All reports foreshadow an early and active spring, and crop reports are generally satisfactory. The iron and steel markets were quiet, but the consumption is very heavy. Shipments of finished materials are of unprecedented proportions, but mills are still well booked ahead. It is stated that a large amount of structural material business is in sight, the orders last month being very heavy. The demand for copper has improved and prices are higher. The week ended with some notable sales for deliveries extending through May and June at 18½ cents for lake and electrolytic. Casting copper is in good request, and there are fair amounts available for pressing requirements. The best brands fetch 18¼ cents. The visible supply of electrolytic is next to nothing. Few of the plants are able to get the volume of metals for keeping the works running to full capacity. Production is slowly increasing in the West and Southwest, but domestic consumption, especially by the electrical trades, keeps equal march with the increased output. Old copper is firm and there is little of it at home or abroad. Old copper wire, in a round lot, brought 18 cents. *Bradstreet's* reports that February failures were 762 in number and liabilities were $9,549,860. The number of casualties was the smallest, with one exception, in February for 14 years past, and was 10 per cent less than a year ago. Liabilities show an increase of 6 per cent over February, 1905, but are 40 per cent less than in February, 1904. The heaviest decrease in number of failures from a year ago was in the South, and the only important increase in liabilities, that reported by the western group, is explained by bank failures in Illinois. Business failures for the week ending March 1 numbered 180, against 186 the week previous and 206 in the like week of 1905.

ALLIS-CHALMERS STEAM TURBINES.—Following the starting of the 1,500-kw Allis-Chalmers turbine unit at Utica, N. Y., 60-cycle, 2,500-volt, two-phase, for the Utica Gas & Electric Company, and the recent installation of a 5,500-kw, 25-cycle, 6,600-volt, three-phase unit at the Williamsburg Station of the Brooklyn Rapid Transit Company, the Allis-Chalmers Company has installed and now under construction 28,000 kw in turbine alternator units. The New York Edison Company, New York City, has on order a 1,500-kw unit, 60 cycles, 2,500-volts, two-phase; the Westchester Lighting Company, New Rochelle, N. Y., a 1,500-kw. 60-cycle, 13,200-volt, three phase unit; the United States Locomotive Equipment Company, Dayton, O., a 1,500-kw, 60-cycle, 2,500-volt, three-phase unit, and the Memphis Consolidated Gas & Electric Company, Memphis, Tenn., a 1,500-kw unit, 60 cycles, 2,500 volts, three-phase. The city of Jacksonville, Fla., recently purchased two 500-kw, 60-cycle, 2,300-volt, three-phase units, and the Western United Gas & Electric Company, of Aurora, Ill., will install a 500-kw Allis-Chalmers turbine and alternator, 60 cycles, 2,200 volts, two-phase. Three 1,500-kw units, 60 cycles, 2,300 volts, three-phase, have been purchased by Mr. John I. Beggs, president of the Milwaukee Electric Railway & Light Company, Milwaukee, for installation in the power house of the handsome new terminal station and office building, which is rapidly nearing completion. The latest additions to the list are the Kokomo, Marion & Western Traction Company of Kokomo, Ind., recent purchasers of a 1,000-kw, 60-cycle, 12,300-volt, two-phase unit, and the Western Canada Cement & Coal Company of Calgary, Canada, which has just placed an order for three units, each of 1,000 kw, 25 cycles, 600 volts, three-phase. For direct connection to each of the turbines mentioned above, the Allis-Chalmers Company furnishes the Bullock alternating-current generator, built at its electrical works in Cincinnati.

MORRISBURG MUNICIPAL PLANT.—Tenders will be received until March 20 by A. A. Logan, Reeve of Morrisburg, Ont., Canada, as follows: For erecting and fully completing in the most advanced methods an electrical development plant of 1,100 electrical horse-power under 9 ft. 6 in. head of water. The tenders to include all and every expense from the beginning of the excavating of earth to the fully developed power, together with about one mile of transmission line from the site of the power plant to the Canada Tin Plate & Sheet Steel Company's buildings, including cable across the Williamsburg Canal, excepting such expenses only as the council of the village of Morrisburg may see fit to incur in the way of inspecting, engineering, etc. All plans and specifications must after selection by the council of Morrisburg be submitted to the Department of Railways and Canals of Canada for their approval before contract can be let thereon. No expense to be incurred by the village of Morrisburg in connection with any tender or plans and specifications submitted for approval. It is desirable to have voltage, etc., to conform to the present electric light plant, namely, volts (no load), 2,080; (full load), 2,300; three-phase frequency, 60 cycles per second. As it is desirable to complete this plant as quickly as possible, each tender should state length of time they will require to do the work in.

POWER IN MICHIGAN.—The Michigan Power Company, of Lansing, is a reorganization of the Piatt Power & Heat Company. The object of the reorganization is for the more extensive development of the water power of Grand River. The capitalization of the new company is $2,500,000, and it is expected that within the next two years at least $1,250,000 will be expended in the construction of additional dams on Grand River and the erection of a new central power heating plant in Lansing, for which franchise has been secured. With the completion of all the power projects of the new company, it is anticipated that 15,000 horse-power will be secured. The financial business of the reorganized power company has been conducted by Devitt, Tremble & Co., of Chicago. The officers of the Michigan Power Company will be: President, A. A. Piatt; vice-presidents, F. B. Piatt and C. C. Carnahan; treasurer, M. A. Devitt; secretary, D. O. Watson. Plans for the new central power and heating plant and for dams at Dimondale and Eagle are now being prepared by W. H. Schott, of Chicago.

WISCONSIN ENGINE COMPANY.—The Wisconsin Engine Company, of Corliss, Wis., W. P. Marr, secretary, acquired by purchase on February 21 the entire plant and equipment, including the patterns and drawings, of the Brown-Corliss Engine Company. The old force of skilled artisans has been retained, and as there has not been any interruption in the operation of the works, the Wisconsin Engine Company is prepared, it states, to engage to build Corliss engines and make unusually prompt delivery. The facilities of the plant are to be increased.

PRESSED STEEL POLE FACTORY.—The Pressed Steel Pole Company, of 505 Times Building, Pittsburg, Mr. John Noland, secretary and general manager, advise us that their new factory is rapidly advancing to completion. The building with all the foundations and handling facilities is practically complete and ready for the installation of machinery, and the plant, it is expected, will be delivered and erected ready for operation during March.

CARS FOR ATLANTIC CITY LINE.—The Wason Car Manufacturing Company has received another order from the Pennsylvania Railroad for eleven large electric cars, to be used on the line between Atlantic City and Camden. The contract calls for five electric passenger cars and six mail and baggage cars, built on the same plan as the other cars. It is a $75,000 order, and is the second from the railroad in a few months.

INDIANAPOLIS, IND.—One of the largest orders ever awarded the Pope Motor Company, of this city, has been placed by the Anheuser-Busch Brewing Company, of St. Louis, Mo., and calls for ten large trucks with an individual capacity of one ton. They will be used for delivery and freight purposes and represent an aggregate cost of $40,000.

THE BALDWIN LOCOMOTIVE WORKS have received an order from the Pennsylvania Railroad for the motor and trailer trucks for the West Jersey & Sea Shore electric line to Atlantic City, the electrical equipment of which is to be furnished by the General Electric Company.

CURRENT FOR ELEVATED.—The Chicago Edison Company is to supply current en bloc to the Metropolitan Elevated system of that city, and the railroad has let contracts for two sub-stations, for $300,000, to receive and distribute the current.

ESCALATOR FOR HARLEM, N. Y.—The Otis Elevator Company, which put up the escalators at Twenty-third Street and Thirty-third Street on the elevated and at Manhattan Street on the Subway, will also construct one at Eighth Avenue and One Hundred and Twenty-fifth Street. After the order is placed it will take 90 days to make as large an escalator as will be needed. Then it takes two or three weeks to install it. The total cost of the change will probably amount to $50,000. It is estimated that from 18,000 to 20,000 persons make the climb at 125th Street every day. There are three long flights of stairs from the street level to the platform of the elevated road, but there are four Otis elevators running to one flight below the platform.

SHIPYARD EQUIPMENT.—The Cleveland office of the Westinghouse Electric & Manufacturing Company has secured a contract from the American Shipbuilding Company for electrical equipment for a power plant to be erected at the Lorain shipyards. There will be two 400-kw generators driven by two 500-hp Atlas engines and two 300-hp vertical type motors will be direct-connected to centrifugal pumps for removing the water from the dry docks. There will also be a 50-hp motor direct-connected to a centrifugal pump for the power station.

TELEPHONE SWITCHBOARD ORDER.—The Dean Electric Company, of Elyria, Ohio, is installing a new switchboard for the Medina Telephone Company. It is a central-energy two-section, five-position board with facilities for party-line service.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market assumed a waiting attitude owing to higher money with continued uncertainty about prospective deals and also about the coal strike situation. At the same time the market rallied easily on the shorts and displayed resistance to attacks of that character. The general impression in Wall Street regarding the coal trade situation is that a miner's strike is less probable, but, on the other hand, a good deal of attention is being given to the discussion of the railroad rate bill in the Senate, and there has also been more or less uncertainty about some of the pending deals, notably the one which has been so much talked about between the Great Northern Railway and the United States Steel Corporation, with regard to the ore lands of the former company. United States Steel shares sold off at first with the rest of the market and were not especially prominent. Metropolitan Street Railway and Metropolitan Securities were the objects of liquidation prior to the announcement of the success of the Interborough-Metropolitan deal. Various industrial stocks also showed a good deal of irregularity. Allis-Chalmers common is down 1½ points and preferred 3¾, the closing quotations being 20⅜ and 56, respectively. General Electric closed at 167¾, which is a net loss of 2¾ points, and Westinghouse lost 1 point, closing at 160. American Locomotive common closed at 68⅝, a decline of 4⅜, and preferred at 116, a loss of ½ point. The traction stocks are all lower with the exception of Interborough Rapid Transit, which made a net gain of ½ point, closing at 228½. Brooklyn Rapid Transit lost 2⅛ points net, the closing quotation being 80⅛, and Metropolitan Street Railway closed at 116, having dropped as low as 111 during the week, this being the bottom price of the year. The lowest quotation for this stock in 1905 was 114. Interborough-Metropolitan is quoted on the curb market at 53, and 4½s, 91½. Western Union Telegraph made a net gain of ⅜ point, closing at 93⅝, and American Telephone and Telegraph declined 2 points, the last quotation being 138. The only feature of the curb market during the week was the continued liquidation throughout the list, the center of pressure being the local traction group. The copper stocks were also freely sold. Declines extended to three to five points in some issues. The influencing factors were the same as governed in the general stock market. The above table shows the closing quotations of the stock market of March 6.

NEW YORK

	Feb. 27	Mar. 6		Feb. 27	Mar. 6
Allis-Chalmers Co.	22¼	20⅜	General Electric	169¼	167
Allis-Chalmers Co. pfd.	59¾	56	Hudson River Tel.	...	...
American Dist. Tel.	37	37	Interborough Rap. Tra.	...	228½
American Locomotive	71¾	67¾	Mackay Cos	61½	60
American Locomotive pfd.	116⅛	115⅝	Mackay Cos pfd.	74¼	73¾
American Tel. & Cable	90	93	Marconi Tel.	...	...
American Tel. & Tel.	138⅛	137¾	Metropolitan St. Ry.	...	115
Brooklyn Rapid Transit	81	79⅝	N. Y. & N. J. Tel.	...	...
Electric Boat	25	27	Western Union Tel.	93⅛	92⅜
Electric Boat pfd	60	65	Westinghouse com.	162	158
Electric Vehicle	17	17	Westinghouse pfd.	...	...
Electric Vehicle pfd.	19	16			

BOSTON

	Feb. 27	Mar. 6		Feb. 27	Mar. 6
American Tel. & Tel.	138⅞	138¼	Mass. Elec. Ry. pfd.	67	67
Cumberland Telephone	118	118½	Mexican Telephone	4¾	4½
Edison Elec. Illum.	...	246½	New England Telephone	138½	138⅜
General Electric	...	167⅝	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	19¾	18⅝	Western Tel. & Tel pfd.	...	99

PHILADELPHIA

	Feb. 27	Mar. 6		Feb. 27	Mar. 6
American Railways	52¼	51	Phila. Electric	8	7¾
Elec. Co. of America	11⅞	11⅝	Phila. Rapid Tran.	31¼	30¾
Elec. Storage Battery	79	78	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Feb. 27	Mar. 6		Feb. 27	Mar. 6
Chicago City Ry.	...	103¼	National Carbon	86	92
Chicago Edison	...	160	National Carbon pfd.	119	120
Chicago Subway	...	...	Union Traction	...	...
Chicago Tel. Co.	...	120	Union Traction pfd.	...	...
Metropolitan Elev. com.	27⅛	28			

* Asked.

CAHILL TELHARMONIC COMPANIES.—We understand that the commercial organization of the Cahill Telharmonic interests (elsewhere explained in this issue) is somewhat as follows: Three exploiting companies, licensed by the inventor, have been former, one for New York State, one for the New England states and one for the Pacific Coast states. In the first two companies named the following gentlemen are directors: H. Carrol Brown, banker; J. William Middendorf, banker; Douglas H. Gordon, president International Trust Co.; A. H. S. Post, vice-president Mercantile Trust Co.; N. W. James, capitalist; F. C. Todd, manager Baltimore office General Electric Co., all of Baltimore; J. G. White, president J. G. White & Co., of New York; Oscar T. Crosby, late general manager Railway Department General Electric Co., of Washington, D. C. The latter is also president of the New York Music Co., and Mr. F. C. Todd is president of the New England Electric Music Company. Both have their temporary headquarters in the Continental Trust Building, Baltimore, Md., but are now engaging New York and Boston offices. The New York Company, through the Telharmonic Company of Greater New York, will make the first installation, for which a lease is now being closed on a prominent Broadway corner. Other local companies throughout New York and New England will be formed at an early date. The Pacific Coast Telharmonic Company has its headquarters in Seattle, Wash. Its officers are Mr. Jas. W. Smith, president; Mr. T. O. Abbott, general manager, and its directors are prominent business men of Seattle.

THE LOS ANGELES-PACIFIC DEAL.—The report is current that the Los Angeles-Pacific Railway Company has disposed of its properties for $6,000,000. The purchaser is said to be E. H. Harriman, of the Southern Pacific, together with Kuhn, Loeb & Co. and the Standard Oil Company. That Mr. Henry E. Huntington does not figure in the transfer, in spite of the generally accepted theory that he has long held an option on the property, is conceded. At the Huntington railway quarters in Los Angeles it is said that such a transfer of the Los Angeles-Pacific would be undoubtedly regarded by Mr. Huntington as a hostile move. For many years Mr. Huntington has been on the most friendly terms with both E. P. Clark, president, and Gen. M. H. Sherman, vice-president of the railway company. It is said that the purchase price of $6,000,000 will be equally divided between Mr. Clark and Gen. Sherman. With the absorption of the Clark-Sherman interests by Mr. Harriman and his associates, it is highly probable that the Southern Pacific's Santa Monica steam line will be electrified at an early date. E. P. Sherman, son of Gen. M. H. Sherman, has been appointed as general superintendent of the Los Angeles-Pacific Railroad Company, while Mr. C. H. Ellison, lately of the Southern Pacific, has been made chief engineer.

ROCKY MOUNTAIN BELL.—One of the rapidly growing Bell organizations is the Rocky Mountain Bell Telephone Company, which has issued its report for the year ending December 31, 1905. It shows as follows:

	1905.	1904.	1903.
Gross earnings	$1,221,774	$1,043,410	$863,144
Expenses	1,003,042	871,640	648,101
Net income	$218,731	$171,761	$215,042
Dividends (6 per cent)	140,228	135,888	134,863
Surplus	$78,503	$35,873	$80,179

TRACTION AROUND BUFFALO.—The report of the International Traction Company of Buffalo, for all systems, shows a gross for the year ending December 31, 1905, of $4,484,643, expenses of $2,483,663, and a net total income of $2,069,542. Interest, taxes and rent, etc., amounted to $1,652,376, expenses for improvements were $345,310, and the net surplus was $71,856. President Pierce, of the International Traction Co., in his report to the stockholders, says that within the last year the company has made long-time contracts for the purchase of pow-

er for the Tonawanda-Lockport-Olcott district; besides, agreements with several suburban roads by which their cars will be brought into the center of Buffalo over the lines of the company. The entire capital stock of the Electric City Railway Co. of Niagara Falls, N. Y., has been purchased at a cost of $108,500. This company owns valuable franchises and has four miles of track constructed. All of the equipment of the International Traction Co. is in use, and 150 new cars, to cost $900,000, have been ordered.

BIRMINGHAM, ALA., BONDS.—The Birmingham Railway, Light & Power Company is offering through Perry, Coffin & Barr and N. W. Harris & Co. $4,633,000 general mortgage refunding 4½ per cent gold bonds, due April 1, 1954; optional for retirement at 105 and interest after 1909. The company controls the lighting and traction services of a population of 133,000, and in 1905 did a gross business of $1,630,000, with net earnings of $721,623. Dividends of 6 per cent have been paid on the $2,500,000 preferred stock since organization and at the rate of 3 and 4 per cent since 1903 on the $3,500,000 common. Of the bonds, $3,058,000 has already been issued out of a total $10,000,000 authorized. The franchises in Birmingham are unlimited or for electricity and gas outside the city are either unlimited or for 29 and 30-year terms. The traction system includes nearly 114 miles.

MASSENA POWER CO. SOLD.—It is announced that the Pittsburg Reduction Company, which is controlled by the Mellons and other capitalists of Pittsburg, has taken over the St. Lawrence River Company, which owns the large water power plant at Massena, New York. The Reduction Company is the principal customer of the St. Lawrence River Power Company, which also serves five or six other industrial establishments in the same neighborhood. The Power Company has outstanding, in addition to $500,000 5 per cent bonds, $3,500,000 of preferred stock and $3,000,000 of common stock. The company is taken over by the Pittsburg Reduction Company on the basis of an issue of $4,000,000 4 per cent. Pittsburg Reduction Company bonds in exchange for all the capital stock of the Power Company. The Reduction Company, moreover, guarantees the principal and interest of the $500,000 St. Lawrence River Power Company bonds.

MASSACHUSETTS LIGHTING COMPANIES.—Gavet & Porter, of Boston, have issued a special circular calling attention to the shares of the Massachusetts Lighting Companies as an investment. This is a consolidation formed under state laws in October, 1903, and the shares are non-taxable. It controls gas and electric companies in the towns of Arlington, Clinton, Leominster, Milford, Spencer and in Worcester county. In all, a population of 100,000 is served. At present it is paying 5 per cent dividends in quarterly instalments. For the year 1905 the net profits were $36,590. Five per cent dividends on $605,500 outstanding stock would call for $30,275, leaving a surplus above dividend requirements of $6,315. The balance sheet shows an apparent floating debt of $41,638, under the head of "bills and accounts payable," offset by "cash and accounts receivable" of $37,196.

DULUTH EDISON BONDS.—The Duluth, Minn., Edison Electric Company is offering $1,000,000 first mortgage 5 per cent. sinking fund gold bonds, due February 1, 1931. The company has $1,000,000 preferred stock and $500,000 common, and the authorized issue of bonds is $2,000,000. The company for the year ending January 31, 1906, reported gross earnings of $262,429 and operating expenses of $131,889, with a net of $130,540, or two and a half times the interest charges on this bond issue. The territory is growing rapidly and the company has a plant of about 3,000 hp, which will soon be supplemented by 5,000 hp of motor generator sets, taking current from the St. Louis River plant of the Great Northern Power Company. The franchise is unlimited. The bonds are being marketed by Perry Coffin & Burr and N. W. Harris & Co.

BELL TELEPHONE OF CANADA.—In order to keep up with the demand for extensions and new exchanges, the Bell Telephone Company, of Canada, at its annual meeting secured authority to apply to Parliament for permission to increase the capital from $10,000,000 to $50,000,000. President Sise said as much new stock would be issued each year as would be needed for extensions. The annual statement showed gross earnings of $3,517,000, operating expenses $2,615,000, leaving net profits of $902,000. During the year $1,910,000 was added to the plants and patent account, bringing it to $11,184,000. The company secured 12,035 new subscribers and now has 78,195 rent-paying instruments. Dividends of $650,215 were paid in 1905.

LIGHTING IN BROOKLYN, N. Y.—The income of the Edison Electric Co., of Brooklyn, N. Y., for the year ending December 31, 1905, was $2,542,733, the operating expenses were $1,351,208, interest and discount, etc., were $762,067, and the net earnings transferred to the Kings County Electric Light & Power Company were $437,872. This holding company paid $400,000 in dividends and showed a net balance for the year of $74,629. The Edison Company has a capital stock of $5,000,000, and consolidated mortgage 4 per cent gold bonds, $4,275,000. The Kings County Company has a capital stock of $5,000,000 first mortgage 5 per cent gold bonds of $2,500,000, and purchase money 6 per cent gold bonds, $5,176,000.

BIG TROLLEY TRANSFER.—The important group of trolley systems in Ohio, known as the "Appleyard group," have passed into the ownership of the Widener-Elkins syndicate. The network includes about 170 miles of road, for which the syndicate paid $1,210,000 and assumed debts to the amount of probably $3,800,000. Apparently there will be little left for the stockholders. Extensions are planned for some of the lines. Mr. W. K. Schoepf is the active head of the syndicate, and Mr. Theodore Stebbins is the general manager of the system which he has been actively directing with success for some time past. The purchase gives the syndicate immediately continuous lines from Cincinnati to Zanesville, O.

PACIFIC STATES TELEPHONE.—The Pacific States Telephone Company for the year ending December 31, 1905, shows as follows:

	1905.	1904.
Total revenue	$7,687,523	$6,824,506
Operating expenses	5,927,054	5,135,485
Net revenue	1,760,469	1,689,021

The company had on December 31, 1905, a total of 242,088 subscribers. Expenditures for maintenance during the year amounted to $2,450,000. The company has $15,000,000 stock outstanding, with no bonded debt, but it has assumed the bonded obligations of one of its sub-companies amounting to $3,000,000.

COLORADO TELEPHONE ANNUAL.—The former directors and officers of the Colorado Telephone Company have been re-elected. President E. B. Field reports gross earnings for year ending December 31, 1905, $1,793,526; net earnings, $396,432. Value of real estate and plant, $6,141,121; number of subscribers, 45,745, a gain of 8,643. Mr. Field says: "To meet the demand for additional telephone service we have decided to offer this year at par to our stockholders $1,400,000 treasury stock." Numerous contemplated improvements and extensions in Colorado and New Mexico are referred to in the report.

INTERBOROUGH MERGER STOCK.—The Interborough-Metropolitan Company, which is the holding company in the New York City traction merger, on March 2 filed with the Secretary of State a certificate of increase in capital stock from $15,000 to $155,000,000. When the company was incorporated in this state recently the capitalization was fixed at $5,000 preferred and $10,000 common stock, and the certificate just filed increased the amount of the preferred stock to $55,000,000 and the amount of the common to $100,000,000.

CUYAHOGA TELEPHONE COMPANY.—J. S. Brailey, J. K. Secor and others of Toledo have made a proposition to the Everett-Moore syndicate of Cleveland for a controlling interest in the stock of the Cuyahoga Telephone Company, the independent plant in that city. These gentlemen already own a large block of Cuyahoga securities, but they desire to acquire control of the property. Their experts are now making an examination of the plant and system.

ELECTRIC PROPERTIES IN DAVENPORT.—A dispatch from Davenport, Iowa, states that papers were signed February 17 by which Eastern capitalists bought all the traction, electric light, power and gas properties in Davenport, Iowa, and Rock Island and Moline, Ill., and the interurban line from these cities to Watertown, Ill. The purchase price is approximately $6,000,000.

RECEIVERSHIP.—The Marquette County Gas, Light & Traction Company, operating the traction system serving Ishpeming and Negaunee and the gas and electric lighting plants there, has gone into the hands of a receiver. E. B. Finch, secretary of the company, has been appointed receiver upon application of the trustees, the Merchants' Loan & Trust Company, of Chicago.

HUDSON RIVER POWER.—The Hudson River Electric Power Company shows a gross for January of $76,038, as compared with $59,783 last year, and a net of $40,217.

GENERAL NEWS.

Construction News.

DOTHEN, ALA.—The City Council has decided to purchase a new engine and dynamo for the electric light plant.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will build several miles of new street car lines within the city limits within the next twelve months.

GOODWATER, ALA.—It is stated that bids will be received now for constructing a hydro-electric power plant near Goodwater, or any part of same. Specifications will be furnished by L. W. Allen, town clerk.

JONESBORO, ALA.—Jonesboro is to have electric lights, and wires are being installed in some of the buildings. This is the first move of the Birmingham Railway, Light & Power Company toward the construction of the new line to this place.

LUJANE, CAL.—The U. S. Reclamation Service, at Lujane, Cal., has recently ordered a 25-hp Allis-Chalmers type motor for installation at Lujane.

MARYSVILLE, CAL.—The Northern California Power Company, Marysville, Cal., has recently made a purchase of a number of Allis-Chalmers oil-filled, self-cooled transformers for capacities 50 and 75 kw.

SAN FRANCISCO, CAL.—City Engineer Woodward has submitted his corrected plans and specifications for the reconstruction, under municipal control, of the Geary Street Railway, and they have been accepted by the Board of Supervisors.

FULLERTON, CAL.—It is reported that an application has been made to the Board of Trustees for a franchise to operate an electric lighting and power system in Fullerton, and bids for the franchise will be received until April 9. G. A. Ruddock is city clerk.

SAN FRANCISCO, CAL.—A petition has been presented to the Public Utilities Committee of the Board of Supervisors by the Home Telephone Company for the establishment of an independent telephone system. The company will invest $2,000,000 in labor and material within twelve months, and $4,000,000 within three years. The Committee is considering the matter.

SANTA ROSA, CAL.—The City Council has authorized Mayor Overton to sign a contract with the Santa Rosa Lighting Company for pumping water and lighting the streets for an indefinite period for $833 a month. It costs the city almost twice that sum under the present arrangement, whereby the municipality operates its own pumping plant and pays the company something like $500 for lighting alone. The company will install a new plant and use electricity for operating the pumps. The city now uses steam for power.

LOS ANGELES, CAL.—According to recent reports the energy of the Colorado River is to be transmitted to Los Angeles, in accordance with plans now being matured by local and Philadelphia capitalists. First, the power is to be distributed among the mining camps on the Arizona and Nevada border, and ultimately brought here. It is claimed that between the Grand Canyon of the Colorado and the Black Canyon it is possible to take advantage of certain sites and develop 500,000 hp. After an investigation of other electric transmission power plants in the State, the waters of the Black Canyon were filed upon over a month ago to the extent of 250,000 miners' inches, by William Carruthers and John Campbell. Plans are now being prepared for a concrete dam 200 feet high. The dam is to be constructed at the lower end of the canyon, and with the fall thus obtained it is calculated that 110,000 hp will be developed at the minimum flow. This power is to be transmitted at a potential of 45,000 volts in the first instance to the mining camps on either side of the Colorado River—Searchlight, Bullfrog and Tonopah, on the Nevada side; and Gold Roads and Chloride on the Arizona side being among the most notable—and later to the coast. The direct line across the desert to Los Angeles would be 260 miles in length—the longest power line in the State.

GUNNISON, COL.—Geo. H. Sethman, of Denver, has secured the contract for constructing water works and an electric light plant for $109,000.

COLORADO CITY, COL.—A committee has been appointed, consisting of Mayor Murray, Alderman C. E. Corporan and others, to investigate the probable cost of a municipal electric light plant.

DENVER, COL.—Announcement was made at the annual meeting of the stockholders of the Colorado Telephone Co. that it will spend between $1,400,000 and $1,800,000 for the improvement of its lines in the Rocky Mountain region during the coming year. The increase in mileage for the past year was 12,816 miles for exchanges and 990 miles of tolls. The toll lines are now 14,569 miles long and the exchanges 78,463 miles.

PLAINFIELD, CONN.—It is reported that the Consolidated Railroad Company is again considering the advisability of securing the water power privilege at the Quinesaug River, two miles west of this village, supposedly for an electric power plant location.

NEW BRITAIN, CONN.—At a recent meeting of the committee on water supply and lights, the estimates were made up for the ensuing year. It was stated that an appropriation of $19,000 will be needed. It was decided that when the new contract is made it shall be for all-night every-night service, instead of on the present moonlight basis.

HARTFORD, CONN.—The Construction Railway Company, operating the Hartford Street Railway and the third-rail line between Hartford and New Britain, contemplates connecting the tracks of the Hartford Company with those of the third-rail line so cars of the latter can be operated into Hartford to the Union Station. This will mean the equipment of the third-rail line with the overhead trolley for its entire distance.

WASHINGTON, D. C.—Bids will be received until March 20 at the Bureau Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies, as follows: Schedule 389, motor, incandescent lamps, voltmeters, conduit fittings; schedule 391, electrical supplies, etc.; also until March 27 to furnish at the navy yard, Pensacola, Fla., and the naval station, New Orleans, La., a quantity of naval supplies, as follows: Schedule 397, incandescent lamps, etc. Applications for proposals should designate the schedules desired by number. H. T. B. Harris, Paymaster-Gen., U. S. N.

LAKE BUTLER, FLA.—The Council has granted to S. H. Mallory a 20-year franchise to operate a telephone exchange in Lake Butler.

PALM BEACH, FLA.—Mr. C. B. McDonald, chief electrician of the Hotels Royal Poinciana and Breakers, Palm Beach, informs us that they propose making extensive improvements in their power stations, house wiring, etc. Catalogue and circular trade matter is requested by Mr. McDonald as to electrical machinery, transformers, meters, insulated wire, etc.

WAYCROSS, GA.—The Waycross Electric Light & Power Company, Waycross, Ga., has recently purchased a 175-kw Allis-Chalmers generator and exciter.

CAIRO, GA.—The town is just completing a municipal lighting and water system and soon the entire city will be lighted by electricity generated at the city's plant.

SYLVANIA, GA.—The question of a municipal electric light plant for the town is being discussed. It is said that a plant could be installed for about $1,600, which would be adequate for the town's needs.

MARIETTA, GA.—The Georgia Mfg. & Public Service Company, Marietta, Ga., has recently purchased an 18 and 36 x 42-in. Reynolds heavy duty cross compound Corliss engine from the Allis-Chalmers Company, builders, Milwaukee.

FREEPORT, ILL.—The People's Telephone Company has been granted a franchise for the construction of a system in Flora.

CHICAGO, ILL.—The Crane Company of Chicago has recently purchased a number of small Allis-Chalmers motors, ranging from 7½ to 25 hp.

JOLIET, ILL.—The American Steel & Wire Company, Joliet, Ill., will install a number of new Allis-Chalmers, 25-hp, direct-current motors, recently ordered.

ROCK ISLAND, ILL.—An agreement has been reached between the Council and the Union Telephone Company and the company will now proceed with the extension of its lines.

GRANITE CITY, ILL.—The Kinloch Long-Distance Telephone Company is preparing to put up a building at Granite City and has let the contract. It will be a two-story structure and will cost about $8,000.

CHICAGO HEIGHTS, ILL.—The Mordon Frog & Crossing Company, of Chicago Heights, Ill., has recently purchased new electrical equipment as follows: One 200-kw Allis-Chalmers type generator, one 30-kw generator and one 30-kw engine type exciter.

SHELBYVILLE, ILL.—The stockholders of the Windsor Mutual Telephone Company have increased the capital stock of that company from $2,500 to $5,000, the increase being necessary on account of the continued demand for telephones along the line.

DUQUOIN, ILL.—The Ohio & Mississippi Telephone Company has taken over the properties and franchises of the Duquoin, Anna, Marion & Carbondale telephone companies. The new company has a capital stock of $100,000 and has established its general offices at Carbondale.

AURORA, ILL.—The Western United Gas and Electric Company, of Aurora, Ill., in selecting the new power and electrical equipment for addition to its present power facilities, recently purchased a 500-kw steam turbine and turbine alternator from the Allis-Chalmers Company, Milwaukee. This unit is the Parsons horizontal, multiple expansion, parallel flow type with a speed of 3600 r.p.m. The turbine alternator is a 2200-volt, 2-phase, 60-cycle machine. The complete unit will be used in connection with the present power house equipment for power and lighting purposes. It is expected that it will be ready for operation early in July.

EDWARDSVILLE, ILL.—The entire plant, franchise and property of the Granite City, Venice & Madison Electric Light Company has been taken over by the McKinley syndicate, operating an electric interurban line through Illinois cities. The Tri-City Company owns a main plant in

Venice and franchises for operating in Granite, Venice and Madison, as well as contracts for the municipal lighting of these three cities. The new management has taken charge. The business will be handled from the main McKinley office in Edwardsville, with a representative on the ground. The McKinley Company acquired the Edwardsville Light & Power plant two months ago.

OWENSVILLE, IND.—The Independent Telephone Company of this city is to install a new switchboard.

INDIANAPOLIS, IND.—The T. B. Laycock Mfg. Company, Indianapolis, Ind., will install twenty standard Allis-Chalmers induction motors, recently purchased.

GOSHEN, IND.—Improvements to the plant of the Central Union Telephone Company are being discussed. The company expects to spend about $50,000 on the local system.

STONY HILL, IND.—Mr. Neal, of Patriot, has been trying to interest the people of this place in the construction of a telephone line here, but nothing definite has been done.

SCOTT CREEK, IND.—The Scott Creek Telephone Company will receive bids for the construction and installation of a telephone plant. George T. Shuck is president of the company.

GOSHEN, IND.—Plans are being discussed for the building of an electric railway between Sturgis, Mich., and Klinger's Lake, north of Elkhart. C. A. Freeland is interested in the project, it is said.

NOBLESVILLE, IND.—T. C. McReynolds, manager of the Kokomo Railway & Light Company, has purchased the electric light and ice plant at Noblesville and organized a new company which will build a new power plant and change the distribution system from 133 cycle, single phase to 60 cycle, two phase. The new company is the Noblesville Light, Heat & Power Company. The capital is $50,000 and the bond issue will be $75,000. The officers are T. C. McReynolds, of Kokomo, president and manager; Frank Holliday, of Indianapolis, secretary and treasurer. The directors are John H. Holliday, Alex. Holliday, Frank Holliday and Oscar Henderson, all of Indianapolis.

MUSKOGEE, I. T.—Engineers are making the surveys for the new trolley line which is projected by the Muskogee Electric Traction Company between Muskogee and Fort Gibson.

MARLOW, I. T.—Bids will be received until March 21 by the Mayor for furnishing material needed in the construction of a water and light system for the town. There will be required boilers, pumps, engine, alternating-current generator, switchboard, cast-iron pipe, standpipe, valves and hydrants. Specifications may be had by addressing the O'Neil Engineering Company, Dallas, Tex.

PHILLIPS, I. T.—The B. A. Electric & Tel. Mfg. Company, of Kansas City, has recently purchased for the Consumers Ice Company, of Phillips, I. T., a lot of equipment for an electric light plant which will consist of the following: One Allis-Chalmers, 18 x 30-in. Reliance engine, belted to a 180-kw, 1100-volt, 60-cycle Allis-Chalmers generator and a 6-kw exciter, rheostats, etc. The new outfit is expected to be ready for operation early in May.

BARTLESVILLE, I. T.—The Bartlesville Electric Light & Power Company, Bartlesville, I. T., has recently purchased additional power house equipment, consisting of a 14 and 24 x 42-in. Fraser & Chalmers tandem compound Corliss engine, a 200-kw direct-current generator, a 60-kw Allis-Chalmers motor generator set and a 2.4-kw belted exciter. The new outfit will be used in conjunction with the present installation to carry the increased power and lighting load.

SHENANDOAH, IA.—The Shenandoah electric lighting plant is to be rebuilt and enlarged at an estimated cost of $25,000.

INDEPENDENCE, IA.—The telephone company is making arrangements to place its wires underground in the business section of the city and will extend its system throughout the city.

SIOUX CITY, IA.—The Sioux City Traction Company will add a new Allis-Chalmers heavy duty, cross compound Corliss engine, 30 and 56 x 60-in., to its present power house equipment.

CEDAR RAPIDS, IA.—The T. M. Sinclair Company, of Cedar Rapids, Ia., is a recent purchaser of a number of motors, types "B" and "H," ranging from 5 to 50 hp and furnished by the Allis-Chalmers Company, Milwaukee.

CLAY CENTER, KAN.—The citizens are in favor of establishing a municipal electric light plant.

NEODESHA, KAN.—The local telephone system is said to have been purchased by C. S. Leeds, who will make a number of improvements in the lines.

HOLTON, KAN.—An election will be held March 29 to vote on issuing $75,000 bonds for water works and an electric light plant. Burns & McDonnell, Kansas City, Mo., are the engineers.

NEODESHA, KAN.—The parties who are asking for a franchise to operate an electric railway on the streets of Neodesha are S. W. Brewster, G. N. Lindsay and Major Massey, all of Chanute, and a Mr. Welch, a civil engineer from Kansas City. Later the line will also be extended to Independence.

BOWLING GREEN, KY.—The Home Telephone Company is to establish an exchange at Russellville.

JEFFERSON, KY.—A number of deeds for right of way have been filed here for the Louisville & Northern Traction & Lighting Company.

PADUCAH, KY.—The Board of Aldermen have voted to award to the street car company a contract to furnish 75 street lamps during the present year. The city will furnish the remainder of the lights.

LOUISVILLE, KY.—The Louisville Lighting Company estimates the cost of laying its wires underground, in accordance with the ordinance now under consideration, at about $350,000, and it is probable that the total cost to all electric and telephone companies will be in the neighborhood of $1,000,000.

LOUISVILLE, KY.—Extensions and improvements aggregating more than $800,000 were decided upon at the annual meeting of the Louisville Railway Company, held a few days ago. The following officers were elected: T. J. Minary, president and general manager; Alex. P. Humphrey, vice-president and general counsel; Samuel G. Boyle, secretary and treasurer.

NEW ORLEANS, LA.—Bids will be received until March 31 by Mordecai T. Endicott, Chief Bureau Yards and Docks, Navy Department, Washington, D. C., for constructing a power house and chimney at the naval station, New Orleans, as per specification No. 1482. Estimated cost, $30,000.

BATON ROUGE, LA.—An extension and a rebuilding of the whole plant and several branches of the Baton Rouge Electric & Gas Company will be made if the City Council will grant the company the privilege of extending its lines over a number of the streets of the city. The plan is for the reorganization of the present street railway company, headed by John D. Fisher, as president.

DEXTER, ME.—A committee has been appointed to investigate the feasibility of establishing a municipal lighting plant, before deciding upon the offer of the Sebasticook Power & Lighting Company.

BRUNSWICK, ME.—Changes have been made in the directorate of the Lewiston, Brunswick & Bath Street Railway Company, due to the recent purchase of a controlling interest in the company by Pennsylvania capitalists represented by John R. Graham.

STOCKTON SPRINGS, ME.—The railroad company has decided to establish an electric light plant for illuminating the piers, docks, yards and stations belonging to the system in this locality. The line will extend from Cape Jellison pier in Stockton to Mack's Point in Searsport. Eighty-two arc lamps will be installed and between these incandescent lamps will be placed.

BRIDGTON, ME.—Massachusetts capitalists have become interested in the proposition to build an electric railway from Harrison to South Windham, and it is believed that the proposed road will be built within a year. The charter granted to the Westbrook, Windham & Naples Railroad Company covered a route through Windham, Naples, Bridgton and Harrison. The company sold out to the Portland Railroad Company after the line from Westbrook to South Windham was built.

LAUREL, MD.—The Laurel Improvement Association has decided to petition the Mayor and Council to establish an electric light plant on Patuxent River.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company is resetting its poles and thoroughly overhauling its electric lines.

MIDDLEBORO, MASS.—The municipal electric light plant will probably be enlarged shortly in order to provide day service for lighting and power purposes.

WINCHESTER, MASS.—The town is discussing the advisability of establishing a municipal electric light plant. Great dissatisfaction is expressed with the service of the present company.

READING, MASS.—Steps are being taken to establish a Board of Public Works which will have administrative jurisdiction over the municipal light plant and the water works. It has also been proposed to operate the pumping plant from the electric light plant, which will necessitate a power line between the two plants, electric motors, transformers and two new pumps to be operated by electricity.

SAULT STE. MARIE, MICH.—An election will be held to vote on the construction of an electric light plant.

BELLAIRE, MICH.—Henry Richardi, of Bellaire, Mich., will install a 375-kw Allis-Chalmers generator, a 25-kw generator and a number of oil-filled, water-cooled transformers recently purchased.

DETROIT, MICH.—An effort is being made to obtain a charter for a subway and system of connecting surface lines in Detroit, to compete with the Detroit United Railway. Mayor Codd and Frank C. Andrews are the local promoters and Prendergast & Rawson, of New York, are said to be financing it.

MT. MORRIS, MICH.—The supervisors of Genesee township have granted to the Detroit, Flint River & Saginaw Valley Railway Company a right of way through that township for an electric railway to connect Detroit and Saginaw.

ST. CLAIR, MICH.—The St. Clair aldermen who caused a deadlock in the Council for seven weeks by objecting to the city entering into a contract to purchase electric power for the operation of the water works, have been finally voted down, the Mayor casting the deciding ballot.

KALAMAZOO, MICH.—Mayor Walter H. Taylor has drafted a tentative franchise for a loop line, to be used by all roads. While the franchise provides that it be built by private capital, there is a clause that the municipality can buy the property at the expiration of the franchise.

BOYNE CITY, MICH.—The Boyne City Electric Light Company has just closed a deal whereby it secures three acres of land along the river front. The company will begin the erection of a new power plant early in April. Prominent Grand Rapids capitalists are behind the enterprise.

BIG RAPIDS, MICH.—The plant of the W. E. Donley Electric Light & Power Company has been put out of commission for an indefinite length of time by the washing out of the company's dam at Big Rapids. The contract for the commercial incandescent lighting has been turned over to Jones & Green.

DEER RIVER, MINN.—The Mesaba Telephone Company has been granted a franchise for a local exchange and will proceed to install a telephone system here.

CROOKSTON, MINN.—Senator A. D. Stevens is interested in the development of water power on Red and Red Lake Rivers. Probably $300,000 will be expended for this purpose.

MINNEAPOLIS, MINN.—Cheaper electric light and power for Minneapolis is promised in the announcement that a party of eastern capitalists will expend $3,000,000 in developing the Elk River properties of the Minnesota Power & Trolley Company and will operate in Minneapolis in competition with the Minneapolis General Electric Company, under the ordinance of the former company passed by the City Council 15 months ago. Under the terms of the franchise the company will furnish electric lights to the city at $58.50 per lamp, as compared with the present price of $94 per lamp; a fixed scale of lighting rates is offered to consumers ranging from 10 cents per kw-hour to consumers whose annual bill is $100 or less; to 5 cents per kw-hour on contracts amounting to $2000 a year; a power scale of 5 cents per kw-hour on $100 contracts ranges to 3 cents per kw-hour in excess of $500 a year; all rates are subject to revision after ten years at each five-year period; the city is to have the right of purchase after ten years of all the property of the company in the city; and the plant must be completed and in operation by November 1, 1907. The development will call for the erection of a 36-feet dam across the river; private right of way for the transmission line from the power plant to the city must be secured, and the local work will consist of the construction of sub-stations, pole lines and conduits. An initial development of 20,000 to 25,000 hp is planned.

NATCHEZ, MISS.—The Board of Mayor and Aldermen has decided to petition the Legislature for permission to issue $75,000 bonds for an electric light and power plant.

JACKSON, MISS.—The officials of the Cumberland Telephone Company announce that they are going to build a line along the right of way of the Gulf and Ship Island Railroad, south from Jackson, and that they are now acquiring the right to construct.

LIVINGSTON, MONT.—John L. Bright has petitioned the Council for a franchise for an electric light plant.

BUTTE, MONT.—The Montana Independent Telephone Company has petitioned for a franchise to establish a local exchange.

HELENA, MONT.—The Home Telephone & Telegraph Company, of Portland, Ore., is seeking a franchise to establish its system here.

MADISON, MO.—The Mutual Telephone Company is preparing to build a central exchange office in this city.

CARROLLTON, MO.—The Bell Telephone Company is making arrangements to place underground its wires in the central portion of the town.

CLINTON, MO.—The citizens have voted to issue $100,000 bonds for water works and an electric light plant. Engineers, Burr & McDonnell, of Kansas City.

FAYETTE, MO.—A new company has been organized, with a capital of $200,000, for the purpose of consolidating the independent telephone systems in Cooper County.

SEDALIA, MO.—The Bell Telephone Company is perfecting plans to establish a new plant here and will install a switchboard of much greater capacity than the present one.

ASHLAND, NEB.—The Ashland Mill & Electric Light Company has decided to rebuild its dam on Wahoo Creek, and remodel its mill race and water gates. F. E. White, general manager.

LAS VEGAS, NEV.—The capacity of the electric light plant is being increased to provide for additional lights which are being installed.

YORINGTON, NEV.—The interests of T. B. Gamble, G. J. Fee, W. N. Harris and Thomas Harris in the Walker River Electric Company that is to erect a large power plant on the Walker River and build an electric line from Wabuska to Bodie, Cal., have been taken over by Mr. Fencher, of San Jose, Cal., who will arrive here soon to look after the preliminary work and the construction of the electric plant. The company has already acquired valuable power sites on the river.

TRENTON, N. J.—Because of the reduction in the bid of the Public Service Corporation for the lighting of the city, 35 new arc lamps will be added to the number now in use in the city. The new contract makes a price of $85 per lamp, against the former price of $92.72.

EAST ORANGE, N. J.—The Council has passed an ordinance authorizing the Ordinance and Street Lighting Committees to engage an engineer to investigate and report on the feasibility of installing a plant for the cremation of garbage, and to furnish electric lights for the streets.

BUFFALO, N. Y.—An item of $250,000 has been added to the budget, to be used in the establishment of a municipal electric light plant.

WEST POINT, N. Y.—Bids will be received until March 17 by the Quartermaster at West Point for erecting a power house, excepting the steel construction.

GLENS FALLS, N. Y.—Hudson River Electric Power Company has been notified to be in readiness on September 1 to deliver electric power for the operation of the West Shore Railway between Utica and Syracuse.

PLATTSBURG, N. Y.—The Knickerbocker Pulp & Paper Company, of Plattsburg, N. Y., will install four 450-kw Allis-Chalmers water-wheel type generators and a 75-kw belted exciter, recently purchased. The new outfit will be used for the electrification of the present mill at Plattsburg.

UTICA, N. Y.—Extensive improvements are contemplated in this section by the Bell telephone interests, and at a recent meeting an appropriation of $2,000,000 was voted for the purpose. Most of this will be expended in the large territory operated by the Central New York and Empire State Companies.

UTICA, N. Y.—Application has been made to the State Gas Commission by the Utica Electric Company for permission to increase the amount of its capital stock from $2,000,000 to $3,500,000, of which amount $342,000 will be used to pay floating indebtedness and provide as far as possible for the construction of transmission lines and the purchase of rights of way. It is proposed by the company to extend its lines from Trenton to Rome, from Utica to Rome and from Utica to Frankfort, Ilion, Mohawk, Herkimer and Little Falls.

ROME, N. Y.—The Hudson River Electric Power Company has closed a contract with the Utica & Mohawk Valley Railway Company to supply the power for the electric service between Utica and Syracuse and the power company's architects and electricians are at work preparing plans for the enlargement of the Utica plant to accommodate the machinery, which will furnish the increased demand for power. The electric company will more than double the capacity of the present building on the flats and will install larger and modern machinery. It will also build one or more substations between Utica and Syracuse for the transmission of power.

CHARLOTTE, N. C.—M. B. Speir, superintendent of the Southern Bell Telephone Company, announces that his company has acquired by purchase the telephone exchange at Statesville, N. C. There are more than 300 lines at Statesville. That city will be connected with Charlotte by a long-distance line and a toll line to Salisbury will soon be completed.

WASHBURN, N. D.—August E. Johnson has been granted a franchise for constructing telephone lines in Goodrich.

ANAMOOSE, N. D.—A petition has been filed for a franchise to establish rural telephone lines in this vicinity.

ELLENDALE, N. D.—Mayor Leiby and others are reported to have formed a stock company to construct an electric light plant.

NEWARK, OHIO.—The Newark Light & Power Company has decided to construct a new power plant, to cost about $100,000.

NILES, OHIO.—Bids will be received until March 21 by B. L. Logan, City Auditor, for $12,000 bonds for improving and equipping the municipal electric light plant.

MASILLON, OHIO.—The Board of Public Service has rejected the bids recently submitted by rival lighting plants in this city and has advertised for new bids to be opened March 16. The rejection was on account of some irregularity.

ALLIANCE, OHIO.—S. F. Haynes, right-of-way agent for the proposed Sandy Valley Traction Company, states that 90 per cent. of the required right of way has been secured.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Company is reported to be considering the building of a new route from Youngstown to New Castle.

COLUMBUS, OHIO.—The State Finance Committee of the Legislature has recommended the passage a bill appropriating $25,000 for the construction of a municipal electric light plant.

AVONDALE, OHIO.—Architects Tietig & Lee, Commercial Tribune Building, Cincinnati, are preparing plans for a power plant and steam laundry for the Jewish Hospital at Avondale, to cost about $40,000.

DALTON, OHIO.—Citizens of this place are endeavoring to induce the Canton & Akron Railway Company to extend its Brookfield branch line to Dalton and they offer concessions in the way of right of way.

AKRON, OHIO.—Thomas L. Childs, promotor of the Cleveland, Akron & Massillon Railway, says that he has completed arrangements for financing the line between Akron and Massillon and that it will be built this year.

CHILLICOTHE, OHIO.—A. G. Moser, general manager of the Chillicothe Street Railway & Electric Light Company, states that the company is planning to install a new engine and generator. He is investigating various makes before placing contracts.

CLEVELAND, OHIO.—The construction of a 16-mile line from Sandusky to Clyde, thus connecting two divisions of the Lake Shore Electric Railway, has been definitely decided upon by that company. The branch will cost approximately $200,000.

FREMONT, OHIO.—The promoters of the Sandusky, Fremont & Tiffin Electric Railway claim to have arranged for the financing of the road between Fremont and Tiffin, and it is stated that arrangements have been made to start construction work in the spring.

McCONNELSVILLE, OHIO.—The Triadelphia-Sayre Telephone Company is constructing a line from Porterville to this city by way of Triadelphia. When completed it will add over a hundred telephones to the Morgan County system. It will be a metallic circuit.

CLEVELAND, OHIO.—The Cleveland Construction Company has practically completed surveys for the line from Youngstown to East Liverpool, nearly all of the right of way has been secured and it is stated that construction work will be started in the very near future.

EAST LIVERPOOL, OHIO.—The Ohio Valley Traction Company, which proposes to build an electric railway from Vanport, Pa., to Smith's Ferry, Pa., has been incorporated under Pennsylvania laws by S. L. Tone, C. S. Mitchell, J. L. Foster, W. B. Carson and A. W. Stevenson.

CLEVELAND, OHIO.—The deal for the purchase of the Detroit, Monroe & Toledo Short Line by the Detroit United Railway will be consummated within a few days. In the very near future through cars will be operated from Cleveland to Detroit by way of the Lake Shore Electric and the Short Line.

HAMILTON, OHIO.—The Mosler Safe Company, of Hamilton, O., has recently purchased more Allis-Chalmers type "N," direct-current motors for installation at the Hamilton plant. The new outfit lately ordered consists of eighteen 9-hp and ten 6-hp motors, one 17½-kw multiple voltage balancing set and a switchboard equipment for same.

PAINESVILLE, OHIO.—Citizens of Painesville are endeavoring to induce R. C. Bacon, of Jefferson, who proposes to build an electric railway from Jefferson to Chardon, to build to Painesville instead of to the other place. It is claimed that Painesville would give a more direct route to Cleveland and that the territory would be better.

PAULING, OHIO.—An election will be held March 19 for the purpose of deciding the question of issuing $10,000 in bonds for municipal ownership of the electric light plant, which is now owned by Columbus Grove capitalists, among whom are G. W. Core, James M. Viers and others. Their contract for lighting in Paulding expires in October of next year.

CINCINNATI, OHIO.—It is said that J. G. Schmidlapp and the Cincinnati Traction Company have come to an agreement over the proposed elevated electric railway from Norwood to the heart of Cincinnati, and that the city company is now prominently identified with the project. Mr. Schmidlapp is endeavoring to secure a franchise from the City Council and the indications are that he will be successful.

SPRINGFIELD, OHIO.—The sale of the Springfield, Charleston, Washington C. H. & Chillicothe Traction Company at receiver's sale recently to a syndicate headed by E. W. Christy, of Cleveland, has been confirmed by the courts. The new owners expect to extend the line to Washington C. H. this summer and plans are being made for a power station and car house at that place. Secretary F. J. Southard, of the new company, has opened general offices in the Bushnell Building and will have charge of work on the extension.

AKRON, OHIO.—The Akron People's Telephone Company has placed a contract with the Automatic Electric Company, of Chicago, Ill., for an automatic switchboard covering the entire system in Akron and surrounding villages. A new building is to be erected and provision will be made for a capacity of 10,000 lines. The initial installation will be for 3700 lines, which gives the company an increase of 500 over the present capacity. New instruments will replace the old throughout. It is the intention to have the system in operation by January 1 next.

YOUNGSTOWN, OHIO.—Strong competition seems likely to occur between the Youngstown & Southern Railway, now operating the line between Youngstown and Columbiana, and the Youngstown & Ohio River Railway, projected by Cleveland people. The latter company is headed by J. R. Nutt, Will Christy, George Stanley, Warren Bicknell and Max Goodman, of Cleveland. It is claimed that arrangements for financing the project have been practically completed, and that the road will undoubtedly be built this year. A large amount of money has already been spent in surveys and right of way.

DAYTON, OHIO.—The plant of the Dayton Lighting Company, which recently underwent an entire alteration, with extensive additions, has been recently placed in operation again. The new power plant, among other features, has added a 1500-kw Allis-Chalmers turbine generator unit, which was installed through the United States Locomotive & Equipment Company, of New York City. This unit operates at a speed of 1800 r.p.m., generating current of 60 cycles, 3 phase, at 2500 volts. The condensing apparatus used in conjunction with the turbine unit was also furnished by the Allis-Chalmers Company, who superintended the erection of the entire unit.

CLEVELAND, OHIO.—The Board of Public Works, of Cleveland, has placed a contract with the Ideal Engine Company for two 100-hp engines and with the Triumph Electric Company for one 50-kw and one 75-kw generator, which will be installed in a plant to supply light and power to the city hall. The city has also received bids for 200 arc lamps for the South Brooklyn municipal light plant, and the contract will be awarded as soon as the efficiency tests are made. It is thought to be the aim of Mayor Johnson to increase the capacity of the South Brooklyn plant sufficiently to light the entire South Side, as a step towards a municipal plant for the entire city.

BANDON, ORE.—The City Council has granted a 20-year franchise to the Bandon Electric Company to construct an electric light plant.

PORTLAND, ORE.—Work is progressing rapidly on the underground system of the Home Telephone & Telegraph Company. When completed there will be more than fifteen miles of trench, and of this amount over one-half is now ready for the cable.

LA GRANDE, ORE.—Walter M. Pierce has closed a deal whereby the Union electric light plant, operated for a number of years by the Hutchinson sisters, becomes the property of the Grande Ronde Electric Company. As soon as transformers can be procured, Union will be connected with the Cove and La Grande power stations.

LAWTON, OKLA.—George Baumhoff, of St. Louis, is in Lawton making arrangements for constructing an electric railway from Lawton to Craterville, the summer resort in the Wichita Mountains by way of Fort Sill. The line will also traverse the city of Lawton.

GUTHRIE, OKLA.—The Oklahoma City, Lexington & Sulphur Springs Electric Railway, now under course of construction, has been purchased by the Commonwealth Trust Company, of St. Louis, which announces its intention of carrying out the plans outlined by the original promoters.

ASHLEY, PA.—The People's Telephone Company will establish an exchange here.

DUNN'S STATION, PA.—The Farmers' Telephone Company is to build a telephone line from Dunn's Station to Amity.

SUGAR RUN, PA.—A farmers' telephone line is to be built from Sugar Run to connect with the Bradford County Telephone Company at Wyalusing.

ELLWOOD CITY, PA.—The Pennsylvania Power Company, Ellwood City, Pa., has purchased a 225-kw Allis-Chalmers water-wheel type generator.

MEADVILLE, PA.—H. S. Robinson, City Clerk, writes that at the election February 20 the citizens voted to issue $58,000 for improvements. This money will be expended for improvements to the electric light plant, sewers and paving.

WAYNE, PA.—J. R. Wiggins & Co. have asked for sub-bids on the plans of Architect J. T. Windrim for a two-story brick and terra cotta telephone exchange which is being erected in this city for the Delaware & Atlantic Telephone & Telegraph Company.

SCRANTON, PA.—Messrs. J. G. White & Company, of New York City, have recently purchased for G. H. Walbridge, Scranton, Pa., two Allis-Chalmers horizontal, cross-compound engines, 23 and 36x42-in., direct coupled to two 500-kw Allis-Chalmers alternators, together with other electrical equipment.

SCRANTON, PA.—The Lackawanna Light Company, formerly the West Scranton Light & Heat Company, has purchased ground for the power house, and the contract for the erection of the building will be let in a few days. The new building will cost about $20,000, and it is proposed to install about $100,000 worth of machinery. The work of laying conduits and stringing wires will begin immediately, preparatory to competing with the older company in the lighting and heating field.

WAGNER, S. D.—John Abasher, of Wagner, writes that he proposes constructing an electric light plant, at a cost of $10,000.

MILBANK, S. D.—The Grant County Telephone Company will install a central-energy system in Milbank. The contract for the new system has been given to the Kellogg Switchboard & Supply Company, of Chicago. Plans are also under consideration for the extension of the line to Alban township.

BAMBERG, S. C.—Bids will be received until March 15 by the Board of Public Works (A. W. Knight, secretary) for furnishing material and installing complete an electric light plant, to consist of two 100-hp high-pressure boilers with cross flue and stack, one 150-hp Corliss engine, one 100-kw Allis-Chalmers 2 or 3-phase revolving-field or inductor generator, 31 arcs, twenty-five 50-cp series lamps with regulator, etc. J. B. McCrary, engineer.

NASHVILLE, TENN.—The Nashville Mutual Telephone Company is to construct lines to Venedy, Okawville and Addieville.

TRENTON, TENN.—The City Council has about completed the purchase of the electric light plant for the city, owned by Freeman & Wade. The price to be paid is $11,000.

GALLATIN, TENN.—G. W. Schanberger and W. H. Sprandlin, of Gallatin, are interested in the Great Cumberland Falls Company, which proposes establishing a lighting and water plant to supply this place and several counties.

MEMPHIS, TENN.—The Memphis Consolidated Gas & Electric Company, of Memphis, Tenn., has recently purchased a 1500-kw Allis-Chalmers turbo-generator unit, with condensing and auxiliary apparatus, for installation at Memphis. The new unit is of the horizontal parallel flow type, designed to operate at a speed of 1800 r.p.m. and generate a current at 60 cycles, 3 phase of 2500 volts; the jet condenser and auxiliary pump to be furnished and also built by the Allis-Chalmers Company. This unit will run in parallel with other units of similar type or with a reciprocating engine unit built for parallel operation, properly dividing the load so as to prevent surging.

UVALDE, TEX.—The City Council has granted two franchises for electric light plants, one to E. L. Burks and associates, the other to Tom Brown and associates.

CANADIAN, TEX.—The Stockmen's Telephone Company, of Canadian, is building lines to Lipscomb and Ochiltree, as well as towns in Beaver and Woodward Counties, Oklahoma.

GALVESTON, TEX.—Application has been made by the Houston-Galveston Traction Company, backed by Houston capital, for a franchise over the streets of Galveston, and the matter has been taken under consideration by members of the Galveston City Commission. An application for a franchise over the streets of Houston is now pending before the authorities of that city.

ALTA, UTAH.—Arthur Murphy, of Alta, has applied to the State Engineer for permission to divert twenty second-feet of water from Little

Cottonwood Creek, the elecetricity developed to be transmitted to Little Cottonwood mining district.

HOLLIDAY, UTAH.—Thomas A. Howard, of Murray, has petitioned the State Engineer for permission to divert seven second-feet of water from Spring Creek, the power produced to be used for electric lighting and power purposes in Holliday.

SALT LAKE CITY, UTAH.—James J. Chambers, president of the Inter-Mountain Company, writes that bids will probably be received about May 1 for the proposed electric plant, to cost about $600,000. Engineer, Frank C. Kelsey, of Salt Lake City.

MURRAY, UTAH.—F. M. Lyman, Jr., of Salt Lake City, engineer and secretary of the company recently organized to construct an electric light and power plant in Mill Creek, writes that the proposed plant will cost $200,000. M. Miller, of Murray, is president.

FARMINGTON, UTAH.—At a meeting of the stockholders of the proposed Davis County Electric Light & Power Company, a temporary organization was established. N. T. Porter, of Centerville, was acting chairman, with Bert Reading as secretary. The following board of directors was appointed to act until the permanent organization is effected at the first annual meeting to be held the last monday in March: James A. Eldredge, Woods Cross; David Stoker, Bountiful; N. T. Porter, Centerville; I. E. Willey, South Bountiful; A. L, Clark, Farming; Henry H. Blood, Kaysville; Wm. I. Layton; H. J. Sheffield, Kaysville; E. P. Ellison, Layton. H. H. Blood, I. E. Willey and N. T. Porter will confer with the Utah Light & Power Company and the Telluride Power Company to obtain bids. The $30,000 stock with which the company will incorporate has nearly all been subscribed.

MORRISVILLE, VT.—A. A. Niles, Village Clerk, writes that at the annual meeting in April, the question of constructing a new dam across Lamille River for the development of additional power will be acted upon.

ROCKFORD, WASH.—H. W. Collins is said to be interested in the construction of an electric light plant.

SEATTLE, WASH.—James A. Moore will ask the City Council for a franchise to construct an electric railway partly within city limits.

SUNNYSIDE, WASH.—The citizens have voted to issue $9,000 bonds, for water works and an electric light plant.

KINGSTON, WASH.—At a recent meeting of the citizens plans for the construction of a telephone line between Kingston and Port Gamble were discussed. It is probable that the work will be started within a very short time.

SPOKANE, WASH.—Franchises have been asked for from the Board of County Commissioners by the State Line Telephone Company, the Spokane Bridge & Liberty Lake Rural Telephone Company and the Valley Prairie Telephone Association.

PUYALLUP, WASH.—The Puyallup Board of Trade has taken steps to introduce an independent telephone system. The committee consists of George D. Spurr, Fred J. Chamberlain, W. D. Cotter and W. E. Hale and W. O. Westcott. Rates of the present company are considered exorbitant. The committee has received reports on the cost of installation of a central-energy system.

WENATCHEE, WASH.—Important changes are taking place in the central part of Washington in the telephone field. The town of Quincy and surrounding country, hitherto without service, is to have two lines. The Pacific States Company is almost ready to string wires between Wenatchee and Quincy, and W. H. Babcock will install a system in Quincy. The Babcock system will connect with the Farmers' line of Wenatchee at Cashmere, Melaga and Leavenworth. It is stated that a company has been formed at Conconnully to purchse the holdings of the Pacific States Company in that part of the State. The system under consideration extends from Pateros to Twisp, Bridgeport, Brewster and Oroville. These lines will be supplemented by several new branch lines. The Perry system will be taken over and a new line built to Wauconda from Riverside. The stockholders of the new company are said to be S. J. Dillabaugh, William Yeagin, Messrs. Stickles, Fairweather, Hormann and others.

ELM GROVE, W. VA.—The National Telephone Company, of Wheeling, is to establish an exchange at Elm Grove.

ENGLESIDE, W. VA.—W. N. Camp, Engleside, W. Va., has purchased recently one 150-kw Allis-Chalmers type "AH" generator and belted exciter.

CHARLESTON, W. VA.—A deal has been consummated whereby the water, natural and artifical gas, traction and other public utilities of Charleston pass into the hands of W. E. Chilton and associates. Mr. Chilton is supposed to represent the Chesapeake & Ohio Railroad. The deal involves more than $1,000,000.

OCONOMOWOC, WIS.—The capital of the Badger Telephone Company has been increased from $5,000 to $10,000.

GLENWOOD, WIS.—The West Wisconsin Telephone Company has increased its capital stock from $7,000 to $15,000.

WEST MILWAUKEE, WIS.—The Chicago, Milwaukee & St. Paul Railway Company will install a 225-kw Allis-Chalmers generator at the West Milwaukee shops.

RACINE, WIS.—The Milwaukee Electric Railway & Light Company is planning to extend its lines from this city to Horlicksville, Franksville, Thompsonville, Raymond, North Cape, Eagle Lake, Brown's Lake and Burlington.

SAUK RAPIDS, WIS.—The Watab Pulp & Paper Company, of Sauk Rapids, Wis., has recently added to the electrical equipment already on order for the new pulp mill now in course of erection, in the shape of two 40-hp Allis-Chalmers type induction motors.

GREEN BAY, WIS.—Albert M. Murphy, W. P. Wagner and others, of Green Bay, owners of the Green Bay Traction Company, have purchased the plant of the Green Bay Gas & Electric Company. It is reported that the two plants will be consolidated and $200,000 expended in improvements.

CHEYENNE, WYO.—The Bell Telephone Company is planning to make extensive improvements in its system here this coming season.

CHEYENNE, WYO.—A syndicate of Denver, Col., capitalists, known as the Northern Colorado Power Company, is reported to have secured options on the electric plants of Cheyenne, Evans, Greeley, Fort Collins, Lafayette ,and other towns in Colorado. It is stated that a system of electric lines connecting these towns will be constructed. Mr. Henry, of the Denver (Col.) Gas & Electric Company, and F. E. Warren, of Cheyenne, are reported interested.

HAVANA, CUBA.—At the stockholders' meeting of the Havana Electric Company, held in Jersey City, N. J., the proposed issue of $300,000 bonds was ratified and directors re-elected. The bonds were issued to provide for proposed extensions of the system.

CHATHAM, N. B.—James Nichol, Mayor, writes that bids will be received until March 20 for an electric light and power station for Chatham.

ST. JOHN, N. B.—Ross & Holgate, Montreal, have submitted their report to this city on the cost of a municipal electric light plant. The report suggests the combination of a garbage destructor and electric light plant, and the estimated cost of constructing the combined plants is $80,000.

BRANDON, MAN.—The Brandon Electric Light Company is preparing to make large extensions to its plant in order to be able to supply the increasing applications for power. The company's city power station will also be extended in the near future.

Company Elections.

DENVER, COL.—At a recent meeting of the Colorado Telephone Company the present directors and officers were re-elected. It was also decided that in order to meet the demand for additional telephone service the company should offer at par to the stockholders $1,400,000 of treasury stock. Numerous improvements and extensions in Colorado and New Mexico are contemplated.

WATERBURY, CONN.—The Perkins Electric Company has elected the following officers: W. W. Mertz, president; E. A. Perkins, treasurer; S. A. Herman, secretary; other directors, J. F. Dewey and F. N. Holley.

WATERBURY, CONN.—The annual meeting of the stockholders of the Woodbury Electric Company was held recently and the following officers elected: F. F. Hitchcock, president; Samuel C. Tomlinson, vice-president; Edward S. Boyd, secretary and treasurer, the other directors being William L. Judson and Arthur D. Warner.

HARTFORD, CONN.—The stockholders of the Hartford Electric Light Company elected the following directors at the annual meeting: Austin C. Dunham, D. Newton Barney, Samuel G. Dunham, William F. Henney, Henry Roberts, Dr. E. K. Root, Willie O. Burr, Ralph W. Cutler, Atwood Collins, Morgan G. Bulkeley, Louis R. Cheney, George G. Williams.

ALPHA, IA.—At the recent business meeting of the Alpha Telephone Company the following officers were elected: C. Carr, president; J. T. Gager, vice-president; E. W. Paul, secretary; W. H. Stone, treasurer.

BALTIMORE, MD.—At the annual meeting of the Maryland Telephone Company and the Baltimore Electric Power Company recently the directors were re-elected as follows: Messrs. David E. Evans, George R. Webb, B. S. Josselyn, Bernard N. Baker, Frank A. Furst, Reuben Foster, Frank H. Callaway, John Waters and John Hubner, all of Baltimore, and Sydney L. Wright, W. Frederick Snyder and Hugh H. Harrison, of Philadelphia.

FRANKFORT, MICH.—The Benzie County Telephone Company held its annual meeting and elected the following officers: William A. Young, Benzonia, president; George C. Woodward, Frankfort, vice-president; Herbert B. Woodward, Benzonia, secretary and treasurer.

PENTWATER, MICH.—The Lake Shore Telephone Company held its annual meeting and elected the following officers: H. S. Newton, president; G. F. Sands, vice-president; J. K. Flood, secretary; L. P. Hyde, treasurer; E. A. Fuller, manager. The present number of telephones in the Ocana Division is 852.

MOUNTAIN LAKE, MINN.—The North Star Telephone Company at a recent meeting elected the following officers: S. Balzar, president; Frank Balzar, vice-president; J. H. Dickman, secretary and treasurer; T. Schroeder, manager.

PORT JERVIS, N. Y.—The Port Jervis Telephone Company has elected the following officers: Moses Dupuy, president; Dr. Cuddeback, vice-president; A. Parshall, secretary; E. F. Mapes, treasurer.

SARATOGA, N. Y.—At the annual meeting of the Hudson River Water Power Company recently in this city the following directors were elected for one year: Eugene L. Ashley, Glens Falls; E. H. Gay, of Boston; W. J. Jackson, Boston; Charles E. Parsons, Albany; Elmer J. West, Glens Falls.

COOPERSTOWN, N. Y.—The Otsego Home Telephone Company has elected the following officers and directors: George R. Fuller, president; George Whitman, vice-president; John Losee, secretary; H. P. McDonough, treasurer and manager. The company will spend $30,000 in new construction this year.

ALBANY, N. Y.—The Hudson River Telephone Company, at its recent annual meeting held in this city, elected the following board of directors: John F. Adriance, Union N. Bethell, Charles F. Cutler, Frederick P. Fish, Henry E. Hawley, D. Cady Herrick, Walter C. Humstone, George P. Ide, James H. Manning. During the present year new buildings will be erected at Kingston, Peekskill, Port Jervis, Fishkill Landing and Watervliet.

SCHENECTADY, N. Y.—At the stockholders meeting of the Schenectady Railway Company, held a few days ago, a new board of directors was elected, representing jointly the New York Central Railroad and the Delaware & Hudson Company. These two roads last year took over control of the Schenectady Railway from the General Electric Company. The directors elected are: E. V. W. Rossiter, John Carstensen, William K. Vanderbilt, Jr., Horace E. Andrews, F. A. Harrington, David Willcox, T. B. Dixey, A. Ekstrom, J. W. Burdick and A. I. Culver.

BROOKLYN, N. Y.—Annual meetings of the stockholders of the Kings County Electric Light & Power Company and of the Edison Electric Illuminating Company were held recently in Brooklyn, when the following board of directors was elected for both companies: Frank Bailey, William Berri, A. N. Brady, N. F. Brady, Horace C. Du Val, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Hugh J. Grant, Seth L. Keeney, Thomas E. Murray, W. F. Sheehan and A. M. Young. Mr. Bailey, who was elected to fill a vacancy, was the only new member. The board subsequently organized by re-electing the retiring officers.

CLEVELAND, OHIO.—The annual meeting of the United States Telephone Company was held recently, and the following directors elected: H. A. Everett, E. W. Moore, C. W. Wason, B. Mahler, C. S. Dickson, Calvary Morris, H. R. Newcomb and C. Y. McVey.

GUTHRIE, OKLA.—At the annual meeting of the stockholders of the Pioneer Telephone Company, which now controls both Oklahoma and Indian Territory, the following officers were elected for the ensuing year: Eugene Nimms, president; John M. Noble, vice-president and general manager; E. E. Westervelt, secretary and treasurer, all of Oklahoma City.

CLARKSVILLE, TENN.—At a meeting of the board of directors of the Home Telephone Company the following officers were elected: Dancey Fort, president; B. F. Gill, vice-president; W. E. Beach, treasurer; H. M. Perry, general manager and secretary.

LEXINGTON, VA.—The Lexington Light & Power Company recently elected the following officers: President, L. H. Latham; vice-president, D. C. Humpreys; secretary and manager, R. E. Hutton.

NIGHTHAWK, WASH.—At the meeting of the Board of Trustees of the Similkameen Falls Power & Development Company, Monroe Harman was elected president of the company; Charles A. Andrus, vice-president; L. L. Work, treasurer, and H. W. Johnson, secretary and manager.

KINGSTON, ONT.—At the annual meeting of the Kingston & Pembroke Electric Railway Company the following officers were elected: President, W. D. Matthews, Toronto; vice-president, W. R. Baker, Montreal; secretary-treasurer, Archibald MacNaughton.

New Incorporations.

HARRISON, ARK.—J. A. Bush and others have been granted a franchise to build an electric railway from this place to Bergman.

DE QUEEN, ARK.—The plant of the De Queen Ice, Light & Power Company has been destroyed by fire. The loss is estimated at $10,000.

YELLVILLE, ARK.—The G. A. Ward Telephone Company has filed articles of incorporation for the purpose of constructing a telephone system through various counties. J. D. Simms is president of the company.

CALDWELL, ARK.—The Caldwell Telephone Company has filed its articles of incorporation. The main office of the new company will be at Forrest City. It is capitalized at $5,000. W. C. Beasley is president.

HARRISBURG, ARK.—The Harrisburg Electric Light & Power Company has filed articles of incorporation showing a capital stock of $25,000. The directors are A. A. Boon, Thomas Flourney, J. G. Gant, M. H. Frayser, Dr. J. C. Davis, Morris Hayuten, Thomas B. Steel, B. F. Cole, J. A. Durham and Lee Weeks. The company will construct and operate an electric light and power plant and water works and manufacture ice.

IMBODEN, ARK.—The Imboden Power Development Company, capitalized at $100,000, has been incorporated. The company now owns and operates the electric light plant, a sawmill and has a large steel water tower erected for the water works, which will be put in operation this spring. The company has a bill before Congress which will authorize the company to construct a dam across Spring River at this point. It is estimated it will develop about 800 hp, thus affording sufficient power for a large number of factories and various other enterprises.

SAN FRANCISCO, CAL.—Articles of incorporation of the Battle Creek Power Company have been filed. The directors of the company are Henry W. Brown and Walter E. Carr, of Colma, Harold L. Wright, Dudley C. Bates and Joseph E. Barry, of San Francisco. The company is capitalized at $1,000,000 and its purpose is to furnish electric power and water.

EATON, COL.—The Eaton Water, Light & Power Company has been incorporated with a capital stock of $35,000, by John McCarthy and others.

SALEM, ILL.—The Farmers' Telephone Line has been incorporated with a capital of $1200. The incorporators are Manson Thurman, Charles Sherman and George S. Mathews.

EDWARDSVILLE, ILL.—The Madison County Light & Power Company, of Edwardsville, has been incorporated, with a capital of $100,0000, by Chas. Zilly, B. E. Bramble and Geo. M. Matters.

ELM GROVE, ILL.—The Elm Grove Mutual Telephone Company has been incorporated with a capital stock of $2,450, by Lewis T. Lipkey, Michael N. Reinhart and Michael Ruch.

TOBINSPORT, IND.—The Robinsport Telephone Company, capitalized at $1000, has filed articles of incorporation.

BROOK, IND.—The Newton & Jasper Counties Telephone Company has been incorporated with a capital of $7500.

FISHER'S SWITCH, IND.—The Highland Telephone Company has been incorporated with a capital of $2,000 and the following directors: Claude Beaver, W. Beaver, C. Sachs and Thomas McCarty.

LEESBURG, IND.—J. E. Armstrong, W. R. Wood and W. H. Slatey are the principal promoters of a company to secure a franchise to construct and install an electric light, heat and power plant in this town.

CUTLER, IND.—The Co-Operative Telephone Company has filed articles of incorporation, with a capital stock of $4,000. William H. Draper, Noah Plank, William Smith, George Phillips, W. S. Hazlitt, George W. Shanklin and James D. Love are the incorporators.

WILLIAMS, IA.—The Mutual Telephone Company has been organized with a capital of $15,000, and will install a local exchange and telephone system.

ASSARIA, KAN.—The Assaria Mutual Telephone Company has been incorporated with a capital stock of $6,000.

BUNKER HILL, KAN.—The Bunker Hill Telephone Company has been incorporated with a capital stock of $12,000.

COLONY, KAN.—The Anderson County Light & Heat Company has been incorporated with a capital stock of $16,000.

BENTON, KAN.—The Benton Telephone Company has been incorporated with a capital stock of $1,000.

HUTCHINSON, KAN.—The People's Water, Light & Power Company has been incorporated with a capital of $150,000.

NEW ORLEANS, LA.—The charter of the New Orleans, Crowley & Western Railroad Company has been filed for incorporation. The capital stock is placed at $1,000,000, and authority is given the company to issue bonds to any amount necessary. It will be an electric road. The road will do a general freight, express and passenger business and will be especially equipped for handling oil, sugar and rice.

LOVELL, ME.—The Independent Telephone & Telegraph Company has been incorporated with a capital of $5,000. C. P. Hubbard is president.

PORTLAND, ME.—The Gas Construction Company has been organized for the purpose of operating gas plants and electric lighting and heating plants. The company has a capital stock of $5000, and the following officers: Fred Bogue, president; W. S. Lee, treasurer.

AUGUSTA, ME.—The American Utilities Company has been incorporated with a capital stock of $3,000,0000, and will build and operate electric railways, electric lighting plants, etc. The officers are M. W. Baldwin, Portland, president; James J. Hernan, of Portland, treasurer.

BOSTON, MASS.—The Old Colony Light Company has filed articles of incorporation, with a capital stock of $50,000. A. F. Chace, E. Bunker and William R. Kelley are among those interested.

JESSIE, MICH.—The Farmers' Telephone Company has been organized with a capital of $5000.

LAKE CITY, MICH.—The Missaukee Telephone Company has been incorporated with a capital of $20,000.

ST. JOHNS, MICH.—The Ovid Mutual Telephone Company has been incorporated with a capital stock of $5,000. E. B. Carpenter is president.

MUSKEGON, MICH.—The Fremont & Hesperia Construction Company has been organized to build an interurban railway to connect Grand Rapids and Ludington.

WALLED LAKE, MICH.—The Walled Lake Telephone Company has filed articles of incorporation in the office of the County Clerk, with $1,000 capital stock. Geo. Dickerson, E. Cahoon, L. S. Carnes and H. F. Andrews are the incorporators.

SANBORN, MINN.—A stock company with a capital stock of $15,000 has been organized here for the construction of three rural telephone lines. F. W. Stevens, G. A. Dreblow and Emil Gerth are the executive committee.

KALISPELL, MONT.—The Western Montana Electric Company has been incorporated, with a capital of $20,000, by L. H. Fauct, of Libby; H. A. Kendall, of Kalispell, and others.

HICKMAN, NEB.—The Hickman Telephone Company has been incorporated with a capital stock of $6,000 by Adam Brendle and others.

PAGE, NEB.—The Page Telephone Company has been incorporated with a capital of $10,000 by C. A. Townsend and others.

LINCOLN, NEB.—The Farmers' Independent Telephone Company, of Wayne and Thurston Counties, has filed articles of incorporation with a capital stock of $7000.

TRENTON, N. J.—The Prairie Telephone Company has secured a New Jersey charter permitting it to construct and operate telephone lines outside of the State. The capital stock is $200,000 and the incorporators are James A. Plotner and C. M. B. Chase, both of Kansas City, and Fred H. Brown, of Parsons, Kan.

CINCINNATUS, N. Y.—The Otselic Valley Telephone Company is to be incorporated with a capital stock of $10,000. The following are the directors of the company: P. C. Wheeler, F. M. Davis, E. W. Terrill, William Edwards, A. Fowlson, J. M. Murray and J. M. Lotridge.

NORWAY, N. Y.—Crockett Ridge & Milletville Telephone & Telegraph Company has been incorporated to operate telephone lines, etc. The capital is $5,000. E. B. Tubb, Norway, president; H. G. Dinsmore, Norway, treasurer.

MARION, N. C.—The Marion Light & Power Company has been incorporated with a capital of $25,000, by J. L. Morgan and others.

FARGO, N. D.—The Pingree Telephone Company has been incorporated, with a capital of $50,000.

BURLINGTON, OHIO.—The North Kenova Telephone Company has been incorporated with a capital of $1800 by A. O'Neil and O. M. Elkins.

NEW PARIS, OHIO.—The New Paris Home Telephone Company has been incorporated by S. C. Richie, P. C. Dowler, A. C. Lindemuth, L. D. Lesh, W. D. Rush. The company's capital is $40,000.

SHELBY, OHIO.—The Shelby Traction Company has been incorporated with $10,000 capital stock by J. E. Will, H. K. Beck, J. W. Williams, A. H. Anderson and A. C. Morse to build a line from Plymouth to Crestline through Shelby with lines diverging from Shelby and Bucyrus in one direction and Ashland in the other. These lines would complete through routes from Cleveland to Columbus.

CLEVELAND, OHIO.—The Highland Telephone Company has been incorporated with a capital stock of $20,000. A. Caig, C. Beaver and A. H. Shaffer are the incorporators.

CRANDALL, OHIO.—The Excelsior Telephone Company has been incorporated to operate a telephone system in Harrison, Floyd, Ashington, Orange and Crawford Counties, Ind. The capital stock is $6,000. John W. Gresham, George E. Sims and A. W. Scheler are the incorporators.

MARTIN'S FERRY, OHIO.—The Dillonville & Ohio River Traction Company, with a capital of $10,000, has been incorporated by James T. Hedgens, Thomas J. Stringer, W. C. Fawcett, Louis Liphart and William B. Francis. The company proposes to build an electric railway connecting Dillonville and Rayland.

CUSHING, OKLA.—The Cushing Telephone Company has been incorporated, with a capital of $2,000, by W. W. Oder and others.

NORMAN, OKLA.—The Norman Telephone Company has been incorporated with a capital stock of $22,000.

CLARION, OKLA.—The Cleo, Cimarron Valley & Western Telephone Company has been incorporated, with a capital of $5,000, by James E. Ely and others.

GUTHRIE, OKLA.—The Pleasant Valley Telephone Company, with a capital of $1200, has been incorporated by H. O. Reeves, W. W. White and others.

LAWTON, OKLA.—The Canadian County Farmers' Telephone Company has been organized with a capital of $50,000, with El Reno as headquarters.

MOUNT HOOD, ORE.—Mount Hood Telephone Company has filed articles of incorporation, with a capital stock of $3.000. The incorporators are W. S. Gribble, C. M. Wishart and I. U. Lafferty.

GRESHAM, ORE.—The Farmers' Mutual Telephone Company has been incorporated by H. W. Shashall, Charles Clevelena, Archie Meyers and Timothy Brownhill. The line will probably be ready for operation in about three months.

EUGENE, ORE.—The Chambers Power Company has filed articles of incorporation, with a capital of $50,000. Frank L. Chambers, George Midgley and Darwin Bristow are the incorporators. The company will construct and operate plants for the production of power, either water, electric or steam, and will also operate mills for the production of lumber, etc.

ALLENTOWN, PA.—The Lehigh Electric Company has been incorporated, with a capital of $10,000, by J. H. Jacoby, A. S. Weibel and others.

ARMOUR, S. D.—Articles of incorporation have been filed and a charter granted to the Chester Telephone Company, of Chester township.

FEDORA, S. D.—The Citizens' Economic Telephone Company has been incorporated with $25,000 capital, to build a county telephone system.

HENRY, S. D.—The Henry Union Telephone Company has been incorporated by J. T. Belk, E. Reinecke and others.

COURTLAND, VA.—The Courtland Waverly Telephone Company has been incorporated, with a capital stock of $5,000. J. N. Sebrell, Sr., president; J. P. Johnson, secretary; Dr. E. F. Reese, treasurer.

New Industrial Companies.

THE WELCH SAFETY THIRD RAIL SYSTEM, Spencerville, Ohio, with a capital of $50,000, has been incorporated by E. M. Welch, Jno. Whyman, J. A. Park and C. A. Wolford.

THE ELECTRIC ADVERTISING COMPANY, of Camden, N. J., has been organized with a capital of $250,000, by Charles Weinfeld, Samuel A. Ettelson and A. H. Heyman.

THE ELECTRIC CONSTRUCTION COMPANY, of St. Louis, Mo., has been incorporated, with a capital of $125,000. Arthur Lambert is one of the incorporators.

THE CENTRAL ELECTRIC COMPANY, of Greensboro, N. C., has filed articles of incorporation, with a capital stock of $25,000. The incorporators are W. C. Waddell, C. W. Petty and C. E. Leak.

THE TAYLOR-HERRICK ROTARY ENGINE COMPANY, of New York, has been incorporated, with the following directors: E. H. Herrick, I. E. Raymond and G. P. Herrick.

THE ELECTRIC SUPPLY & CONSTRUCTION COMPANY, of La Crosse, Wis., has filed articles of incorporation, with a capital stock of $10,000. Robert J. Nichols, Will D. Burford and E. D. Burford are the incorporators.

THE INTERNATIONAL ELECTRO-CHEMICAL COMPANY, of New York, N. Y., has been incorporated, with a capital of $10,000, and the following board of directors: W. F. McCarty, Rocky Ridge, Md.; C. E. Fisher and T. A. Darby, of New York.

FRANK D. COOK, Chicago, Ill., has filed articles of incorporation and will engage in the manufacture of telephones. The capital is placed at $100,000. Associated with him are Emma A. Olsen, Mary R. Rochford and Elizabeth R. King.

THE BROWNELL-TREBERT COMPANY, Rochester, N. Y., has been incorporated and will manufacture automobiles. The company is capitalized at $50,000, and the following are named as directors: F. A. Brownell, H. L. F. Trebert and Paul Le Hardy.

THE EDWARD E. CARY COMPANY, of New York, has been incorporated with a capital of $20,000. The company will manufacture electrical apparatus. P. C. Fredericks, Dean Emery, R. W. Crawford, of New York, are the incorporators.

THE J. G. BARR ELECTRICAL COMPANY, St. Louis, Mo., has made application for incorporation. The incorporators are Jesse G. Barr, Wade H. Bush, Frank J. Daugherty, Ernest C. Krauss and Marion E. Loftus. The object of the incorporation is to manufacture and deal in electrical appliances, fixtures, machinery, etc. The capital stock is $10,000, fully paid.

THE STARK SIGN COMPANY, of Canton, Ohio, has been incorporated with a capital stock of $10,000 by P. F. Dittenhaver, William Schontz, Luther Day, Thomas St. John and others. The company will absorb the Dittenhaver Sign Company and will make electric and special signs of all descriptions.

Legal.

THEFT OF KEY SOCKETS.—In the Criminal Court of Chicago, Cook County, a jury on Thursday, March 1, brought in a verdict of guilty in the case of the People vs. Ralph Lipsey, indicted for receiving stolen property, the penalty for which is imprisonment in the penitentiary for not less than one year nor more than ten years. In this case the jury found that Lipsey, who was the president of the Great Northern Metal Company, 61 West Van Buren Street, Chicago, had received and again disposed of four cases of key sockets which had previously been stolen from one of the large jobbing houses of Chicago. Many of the jobbing houses have suffered more or less from petty thieving, as well as from graver acts of stealing, involving often goods of considerable value, and the electrical jobbers and manufacturers of standard supplies have taken much interest in this case. The disclosure of the fact of receiving stolen property is one of the most difficult capable of legal proof, and, in this case, the defense left no stone unturned to escape the jury and the verdict of guilty. The commission of this offense is one that is a constant menace to the legitimate trade, for, unless the thief can find a fence to dispose of the stolen goods, there would be few, if any serious cases of this nature. The evidence in this case was prepared by Frederic P. Vose, lawyer, Marquette Building, who assisted States Attorney James Barbour in the prosecution of the case.

TIME STAMP LITIGATION.—In the case of the Calculagraph Company of New York vs. Jno. C. Wilson, which was a suit brought under the patents of Hamilton & Abbott to enjoin the Automatic Time Stamp Company from making or selling an instrument known as the "Timeometer" used on telephone toll-line switchboards to record the time the toll-line was in use by a customer, the U. S. Circuit Court of Appeals in an opinion by Judge Colt has reversed the decision of Judge Hale, of the U. S. District Court, and has remanded the case to the Circuit Court with directions to dismiss the bill of the Calculagraph Company with costs in the Circuit Court and in the Court of Appeals. Judge Hale had also found the defendant in contempt for making another machine for the same purpose, known as the "Duragraph," and this decision of the Court of Appeals acts to void this finding also. J. S. Rusk and Fredk. L. Emery, counsel for appellant. E. J. Prindle for appellee.

Obituary.

WILLIAM ALFRED HOVEY, of the American Bell Telephone Company, well known in journalistic and literary circles, died in Boston on February 18, aged 64 years. He was at one time president of the Merchants' Electric Light & Power Company, and in 1884 he became editor of the *Electrical Review*. In 1885 he associated himself with the American Bell Telephone Company, with which he remained up to the time of his death.

MR. F. R. GILLINDER.—Mr. Frederick R. Gillinder, president and senior member of Gillinder & Son's Franklin Glass Works, Philadelphia, died at his home there, last week, of general debility. He was born in England in 1845 and succeeded his father, who founded the Franklin Flint Glass Company, and was president of the Glass Manufacturers' Association. He served as a volunteer in an emergency regiment during the Confederate raid into Pennsylvania, in 1863. He leaves a widow, two sons and a daughter.

MR. CHARLES H. KILGOUR, who was prominently connected with street railway and telephone systems in Cincinnati, died at his home in that city last week. He built and operated many of the original horse lines in the city, entering the business in 1869. It was under his guidance that the street car lines were first equipped with cable, then electrified and finally merged into the present system. He left a fortune estimated at $5,000,000. For a number of years he had led a retired life, devoting his time largely to charities.

MR. FRANKLIN BROOKS.—We regret to note the death of Mr. Franklin Brooks, well known as vice-president of Eugene Munsell & Co. This sad event occurred at his home in Elizabeth, N. J., March 5. He had been ill for three months or more with rheumatism, and had lately gone to Summerville, S. C., for treatment. He grew rapidly worse and being brought home succumbed shortly afterwards. Mr. Brooks was born in San Francisco fifty-one years ago, and came East with his parents when but a child. The elder Brooks was interested in a mica mine in North Carolina, and there the son spent several years, acquiring knowledge of the mineral which made him widely known as an expert. He associated himself with his cousin, Eugene Munsell, in the firm of Munsell & Brooks and dealt in mica. Later Eugene Munsell, Franklin Brooks, Lewis W. Kingsley and William H. Rollo bought out the Munsell & Thompson Manufacturing Company, and this and the firm of Munsell & Brooks were consolidated into the firm of Munsell, Rollo & Company. This firm was later dissolved and the firm of Eugene Munsell & Company was formed, and of this firm Mr. Brooks was a member till his death. He was also vice-president of the Mica Insulator Company, and a director in two mica mining companies operating in North Carolina. The firm is also interested in the output of mica mines in India, and a few years ago Mr. Brooks visited there, while on a trip around the world. Mr. Brooks was president of the Mattano Club, a member of the Elizabeth Club and of the Elizabeth Town and Country Club, and a director of the Union County Trust Company. He was widely acquainted and was everywhere a great favorite. He was of a genial, generous disposition. Mr. Brooks married Miss Julia G. Van Horn, of one of the old Dutch families of Jersey City. Besides his wife, Mr. Brooks leaves one son, Eugene F. Brooks, and two daughters, Miss Marion and Miss Josephine Brooks.

Personal.

H. C. THAXTER.

MR. H. C. THAXTER, of the Standard Electric Works, San Francisco, Cal., was born in Carson, Nev., March 24, 1872, where he received his earlier education until 1889, going in that year to Terre Haute, Ind., to enter the Rose Polytechnic Institute. He studied there for two years, leaving with Dr. Jordon and the Indiana contingent for Stanford University, Cal., in 1891, from which institution he graduated with the degree of B.S. in electrical and mechanical engineering in 1894. He entered the employ of the Los Angeles Railway in the winter of the same year, in whose service he was rapidly advanced through its several departments to the position of superintendent of motive power in 1896. At this time the West Side Lighting Co. of Los Angeles was negotiating to become an Edison licensee, and desiring to obtain the services of a thoroughly reliable engineer, offered special inducements to Mr. Thaxter to become their engineer and general suprintendent, which position he accepted in 1896. That the choice of the Edison Company was a wise one has been demonstrated by the rapid growth of their plant from a 200-hp high-frequency station to one of 5000-kw capacity with three steam stations, one hydro-electric sub-station, with an auxiliary storage battery for supplying a large underground area, during the seven years of Mr. Thaxter's incumbency. In 1903, he was offered and accepted a position as general manager of the Asphalt Paper Pipe Co., which later became the American Conduit Company of Los Angeles and Chicago. Desiring to return to the lines of his profession he resigned from this company in 1904 to take the position of engineer and general superintendent of the Standard Electric Company of California, where he remained until that company was absorbed by the California Gas & Electric Corporation, when he entered the employ of the Standard Electric Works of San Francisco, Cal., as engineer and asssistant manager, which position he still holds at the present writing. This company is a member of the National Jobbers Association, and besides doing a general construction business represents as Pacific Coast agent numerous Eastern factories for various lines of electrical appliances. Mr. Thaxter has been largely instrumental in bringing the Standard Electric Works to the front as one of the leading electrical firms on the Pacific Coast. His services are also in frequent demand by a numerous clientele as a consulting electrical engineer.

H. E. NIESZ.

MR. HOMER E. NIESZ, whose efficient work as a director and in charge of publicity for the Chicago Electrical Show have resulted in his being made managing director of the show for next year, is assistant to the second vice-president of the Chicago Edison Company. He was born in Canton, O., in 1868 and educated at Mt. Union College, Alliance, O., from which he graduated in 1886. During his course he specialized in civil engineering with the idea of taking up that work. After graduation he engaged in electrical work, first with the Western Electric Company, of Chicago, and later with the United States Electric Lighting Company, and with Leonard and Izard. In 1888 he entered the employ of the Chicago Edison Company as wireman and rapidly rose from one grade of work to another until in 1889 he was made assistant superintendent of the construction department. This position he held for ten years. In 1889 he was made assistant to Mr. L. A. Ferguson, then general superintendent, in which position he continued when Mr. Ferguson became second vice-president. Mr. Niesz has written for the technical press, and in 1905 edited the National Electric Light Association Question Box. In the latter connection he did excellent work, appreciated by all central station men who have occasion to refer to the Question Box. He was one of the incorporators of the Chicago Electrical Show and took an active part in the management of this year's show, which, as said before in these columns, was a remarkable success, having an attendance of 101,000 in 12 days. In taking up this work Mr. Niesz does not in any way relinquish his duties as assistant to second vice-president of the Chicago Edison Company, from which office he will carry on the work of the exposition for the present.

MR. F. A. BERTRAND, formerly of the Springfield, Mo., Gas & Electric Company, has become interested in and will manage the Jefferson City, Mo., Light, Heat & Power Company.

MR. CHARLES J. GOLDMARK, consulting electrical and mechanical engineer, has removed his offices in New York to 7 West 38th Street, a district that bids fair, with the opening of the United Engineering Building, to become the great center in New York for professional men in the engineering fields.

PROF. W. HALLOCK, of the physics department of Columbia University, New York City, has been appointed dean of the faculty of science, in place of Prof. E. B. Wilson, resigned. Prof. Hallock is widely and favorably known in the scientific field and has a wide acquaintance among electrical engineers.

MR. N. McD. CRAWFORD, formerly general manager of the Hartford Street Railway Company, and more recently engaged in engineering work at Hartford, Conn., is making a trip to England and other parts of Europe, in connection with the municipal ownership investigation of the National Civic Federation. He will probably be occupied there for three or four months.

MR. HENRY FLOY.—Napier & Mitchell Mfg. Company, of Belleville, N. J., is enlarging its factory by the erection of two new buildings, contracts for which have already been let. All the power and lighting will be electrically distributed. Two-phase, 240-volt motors and a generator direct-connected to a high-speed engine, will be installed. Mr. Henry Floy is the consulting engineer.

MR. G. F. DINSMORE, treasurer of the Hatch Accumulator Company of Boston, has been visiting New York this week in the interests of his company. Mr. Dinsmore is a chemist and physicist, and during the past 15 or 20 years has done a great deal of original research, not only in chemistry, but in the deeper problems that touch the constitution of matter and the conservation of energy.

MR. GEORGE W. FOWLER, who has been actively engaged in the electrical engineering business for several years past, has established himself at 136 Liberty St., New York, as consulting electrical engineer and power expert. Mr. Fowler was formerly connected with the C. & C. Electric Company, and more recently has engaged in engineering construction. He will devote his attention especially to the application of electric power to industrial and manufacturing establishments.

MR. FRANCIS E. DONOHOE, who has had charge of the Chicago office of the American Electrical Works for the past twelve years, has been transferred to the position of sales agent at their New York office. His predecessor, Mr. W. J. Watson, resigned March 1 to engage in the real estate business on Long Island. Mr. Donohoe handed over the management of the Chicago office to Mr. E. H. Hammond, who has been assisting him there the 12 years Mr. Donohoe was in charge.

MR. HUBERT H. MACRAE.—The construction work of the Electrical Development Company and the Toronto & Niagara Power Company is now approaching completion and it has been considered necessary to appoint a general manager who will give undivided attention to the operation of the companies. Mr. Frederic Nichols has therefore retired from that position and is now first vice-president and managing director. Mr. Hubert H. Macrae, solicitor for the two companies, has been appointed general manager and will assume the duties as soon as the necessary arrangements can be completed.

MR. JOHN F. WALLACE, formerly chief engineer of the Panama Canal Commission, will in a few weeks take an important position in the Westinghouse Companies. This step was rumored when Mr. Wallace left the Commission, but the news was very indefinite then as, indeed, it is to-day. It is understood that a new Westinghouse company is being organized, of which Mr. Wallace will be the president, but the official announcement on the subject is not expected before the end of the present month. Mr. Wallace before serving on the Canal Commission was chief engineer of the Illinois Central Railroad, and has always enjoyed a high reputation in engineering circles for his technical ability and attainments.

Trade Publications.

SWITCHBOARDS.—The Worcester Electric Manufacturing Company, 42 Lagrange St., Worcester, Mass., has issued circular No. 4, dealing with standard switchboards for 250-volt circuits. The switchboard instruments are of any style selected by the purchaser.

MICHIGAN CEDAR POLES.—A neat little brochure, letter size, has been issued on the subject of Michigan white cedar poles, by the Kellogg Switchboard & Supply Company, of Chicago, Ill. It gives a view of its large yard at Wilson, Mich., and includes a variety of data, specifications, etc.

HAZARD MANUFACTURING COMPANY, the well-known manufacturer of insulated wires and cables at Wilkesbarre, Pa., has issued a handsome, large, broadsheet calendar for 1906 that is useful for any office or plant where the day of the month should be plainly in evidence. Each date has a space about 2 by 3 inches.

CENTURY TELEPHONE CONSTRUCTION COMPANY, of Buffalo, N. Y., has got up an attractive long distance "ad." which it has been using to good advantage in advertising independent telephone service. These celluloid triangular discs are mounted on the transmitter, being held in place by the mouthpiece, and bear the "Independent" shield in colors.

WARD LEONARD ELECTRIC CO., Bronxville, N. Y., has issued a catalogue, No. 19,062, covering motor starters equipped with 20 steps of resistance for speed control by field regulation. It includes cuts, diagrams of connections showing internal connections, full descriptions, prices, etc., covering both the plain no-voltage release type and the interlocking overload circuit breaker and no-voltage release type. This catalogue will be sent upon request.

INTERURBAN RAILWAY JOURNAL.—Mr. J. T. Elliott, Jr., American Central Life Building, Indianapolis, gives notice that he has been appointed receiver for the *Interurban Railway Journal* of that city. Creditors can file claims until March 10. This was an attempt to issue a special paper to cover interurban railway work, but that department of technical journalism is already well filled, and it was soon shown that no necessity existed for this publication. Mr. E. H. Talbott was the editor.

McLEOD, WARD & COMPANY, 27 Thames Street, New York City, desk lamp specialists, have just issued a broad sheet of their fixtures and portables under the title: "Light Where Needed." It shows no fewer than twenty-three styles and varieties of desk lamps, pulpit lamps, bracket lamps, orchestra lamps, picture lamps and other useful specialties; and illustrates also the Ward "Double-joint," through which the flexible cord runs, and which gives free play to the movement of the lamp in any direction. These Ward and Kinsman specialties have been a great boon to the public, and to-day if they were more generally pushed by central station companies, or installed by isolated plants, there would be a much keener appreciation of the value and beauty of the electric light.

News of the Trade.

THE ELEKTRON MANUFACTURING COMPANY, of Springfield, Mass., has made arrangements to manufacture the "Sulton" car, a well-known French model, in connection with its other work at the factory in this city.

CHANGE OF STYLE.—The C. H. Wheeler Condenser & Pump Company, on account of the delay and confusion due to the similarity of its name to that of another concern, has changed its corporate name to C. H. Wheeler Manufacturing Company.

THE BASTIAN METER, a well-known British meter of the electrolytic type, is handled in this country by the Helios Manufacturing Company of Bridesburg, Philadelphia, Pa. Mr. Frank S. Marr, president, informs us that the Bastian Meter Company claim that 80 per cent. of all the meters used in Australia are of its type and make.

FREVERT MACHINERY COMPANY has opened salesroom and offices at 18 Dey Street, New York City, where it carries a complete line of new and second hand metal working tools and machinery of every description. It is also manufacturing a line of newly designed hand power traveling cranes, trolleys, hoists and overhead tracks, which are said to embody a number of improvements and new features. Mr. H. F. Frevert, the head of the concern, has had a large experience in the machine tool business.

VULCAN SOLDERING TOOLS.—L. P. Brown & Co., 71 West Jackson Boulevard, Chicago, have recently enlarged their quarters and are catching up with orders for their Vulcan electric soldering tools. A number of improvements have lately been introduced into the goods, and Mr. F. J. Holmes, the manager, says: "The original No. 10 has been superseded by the No. 100, which is identical in size with the No. 10. In the No. 100 the parts are brazed together, the outside shell being brazed on after the winding is in place. We, therefore, have a completely closed winding chamber, the winding being, as it were, embedded in a solid metal body, and thus protected from the soldering flux fumes and the intense corrosive effect which always results from the action of these fumes. We have so changed the construction of the renewable copper tip as to do away with the possibility of the tip becoming stuck and immovable. The make-up of the tool has also been changed in such a manner that the copper core is located in the body of the appliance, enabling us to reduce the price of extra tips from 50 cents to 30 cents each. The No. 200 has been developed along lines similar to the No. 100, and the larger sizes which we are now preparing will have the same construction. We are confident that electrically heated soldering coppers will rapidly replace those heated by gas, gasolene or charcoal. As a matter of fact, we are now putting these tools into many manufacturing establishments in place of the obsolete devices which are being abandoned."

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 27, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nasau St., N. Y.]

813,403. THERMOSTAT; Arthur D. Colton, Chicago, Ill. App. filed Aug. 22, 1904. A rod of expansible material acts to move a multiplying lever between contact points for the alarm or control circuit. The contact point may be adjusted simultaneously by an index, for different temperatures.

813,410. MOTOR CONTROL; Charles A. Eck, Newark, N. J. App. filed May 16, 1905. The combination with a motor having poles and an armature, of an adjustable yoke-ring having a series of portions of large cross-sectional area, each somewhat longer than the distance between the poles, and having portions of small cross-sectional area connecting the portions of large cross-sectional area.

813,419. SELECTIVE SIGNALING SYSTEM; Charles G. Hawley and Herbert O. Holderness, Chicago, Ill. App. filed Dec. 15, 1903. A system of cabinets for train dispatchers and others in which dials along the route are moved synchronously by step by step magnets. The proper number of pulsations is transmitted from different levers by a sort of fire alarm arrangement.

813,426. SIGNALING SYSTEM; Herbert O. Holderness and Charles G. Hawley, Chicago, Ill. App. filed Feb. 17, 1902. Relates to modifications of the above and particularly to the details of the cabinets and indicating dials used at the various stations along the route.

813,472. ELECTRIC MACHINES; Edward J. Willis, Richmond, Va. App. filed Feb. 8, 1905. An element for induction electric machines provided with a plurality of rods extending longitudinally beyond the ends of the element and a plurality of bonds consisting of naked wires spaced apart and extending entirely around said element upon said extended ends and each bond electrically connected with each rod at each contact point.

813,512. CIRCUIT CLOSER FOR TELEGRAPH KEYS; Herbert R. Nevens, Portland, Me. App. filed June 14, 1905. In order to prevent accidental displacement of the circuit closing lever of a telegrapher's key, the patentee provides a spring which exerts a tension to close the lever at all except its extreme open position.

813,515. TROLLEY SUPPORTING DEVICE; Alexander Palmros, Columbus, O. App. filed Apr. 11, 1900. Adapted for mine locomotives in which the trolley pole swings in a horizontal plane against the conductor. A tension spring is connected to a short crank so as to press the pole against the wire whether the pole is in its forward or rearward relation.

813,523. BRUSH HOLDER FOR MOTORS OR GENERATORS; Frank L. Sessions, Columbus, O. App. filed May 20, 1903. The brush is guided longitudinally in a fixed casing or support, and has a supplemental spring-pressed lever engaging its outer end to press the brush against the commutator.

813,526. GROUND CONNECTION FOR ELECTRIC CIRCUITS; Joseph B. Simpson, Washington, D. C. App. filed Apr. 11, 1905. A two-part metallic ring has its adjoining ends arranged to interlock in a plurality of different relations so that the effective diameter of the ring is changed, and can be accorded to any size of pipe.

813,532. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF METALS OF THE EARTHY ALKALIES; Carl Suter and Berthold Redlich, Ratibor, Germany. App. filed Jan. 2, 1904. A process for the electrolytic production of metals of the earthy alkalies consisting in melting the salt, effecting the electrolysis thereof, and causing a slow movement of the cathode from the surface of the electrolyte during the action.

813,538. CONNECTOR FOR ELECTRICAL CONDUCTORS; Frederick J. Troll, Baltimore, Md. App. filed Apr. 3, 1905. A connector for flexible wires designed to give them the characteristics of solid wires at the connection point. Soft copper sleeves or tubes surround the

bared flexible cable, and portions of the sleeves extend over the insulation thereof.

813,546. INCLOSED SAFETY DEVICE FOR FUSES FOR ELECTRICAL INSTALLATIONS; Wilhelm Fellenberg, Charlottenburg, Germany. App. filed Apr. 28, 1904. The fuse receptacle has a zig zag channel therethrough in which the fuse wire is contained. The interior is closely packed with powdered emery, talc or absorbent substance to prevent damage by the hot gases.

813,560. TELEPHONE SYSTEM FOR CENTRAL STATIONS; Gustaf Lambert, Charlottenburg, Germany. App. filed Apr. 16, 1902. A telephone system comprising a loop conductor line connected to the central station, and a pair of electromagnets in the respective branches of the loop with selective means actuated by one to short circuit the other until the call is answered.

813,568. INCANDESCENT LAMP SOCKET; Robert R. Miller, Grand Rapids, Mich. App. filed Jan. 3, 1905. Instead of a turn button the patentee provides a short centrally pivoted lever with a knob at each end so that the lever can be thrown to its alternate position by a simple pressure on one or the other knob.

813,582. ELECTRIC STORAGE BATTERY; Harris H. Porter, Providence, R. I. App. filed Sept. 21, 1903. A porous separator for secondary battery plates having on its faces a series of flat surfaces and grooves, said surfaces being substantially wider than said grooves and the surfaces on one face being opposite the grooves on the other face.

813,610. CLOCKWORK ELECTRICITY METER; Hermann Aron, Charlottenburg, Germany. App. filed Jan. 13, 1904. Relates to a form of meter having two clock driven pendulums each carrying a shunt coil which is thereby vibrated in a series field so that the speed of movement is controlled. The present invention relates to a means for compensating for inexact leveling of the instrument, and includes a special form of suspension spring.

813,638. ELECTRICALLY OPERATED CONTROLLING MECHANISM; George H. Fretts, Springfield, Mass. App. filed May 13, 1905. The switch point is connected to the short arm of a double bell crank

813,660.—Lightning Conductor.

lever moved by two solenoids. Motion is normally arrested by two detents which are released by the induced magnetism of the solenoids cores.

813,660. LIGHTNING CONDUCTOR; Thomas H. Miner, Winona, Mo. App. filed May 1, 1905. A construction of lightning arresters forming a frame adapted to follow the lines of the building to be protected.

813,662. ELECTRICAL RAILWAY SIGNAL; August W. Nelson, Spokane, Wash. App. filed May 11, 1905. Relates to details of construction of a tappet adjacent the track rail and adapted to be engaged by the wheel flanges. Has a roller supported by an upwardly spring-pressed plunger.

813,682. THERMOPILE; Meyer Wilderman and Robert L. Mond, London, Eng. App. filed Aug. 14, 1905. In order to secure a large number of perfectly connected elements, the patentee electroplates a platinum wire with an iron coating, and then etches the wire so as to remove the coating at spaced periods or sections along its length. The wire is then wound so as to expose corresponding section ends to the heat source.

813,685. ELECTRICITY METER; Hermann Aron, Charlottenburg, Germany. App. filed Jan. 13, 1904. Provides means for automatically exerting a retrograde movement to the recording mechanism when the flow of working current ceases and additional means for detaining the same against such retrograde movement.

813,688. APPARATUS FOR PREPARING BLEACHING LIQUORS; Friedrich L. Bartelt, Bristol, England. App. filed Oct. 7, 1904. An apparatus for preparing bleaching liquor comprising a solution tank, a float therein, an electrolizer at a lower level than the tank, and a bleaching liquor tank below the electrolizer in combination with a source of electricity in circuit with the electrolizer, a bell circuit and a electrolizing circuit including a switch adapted to be closed by the float.

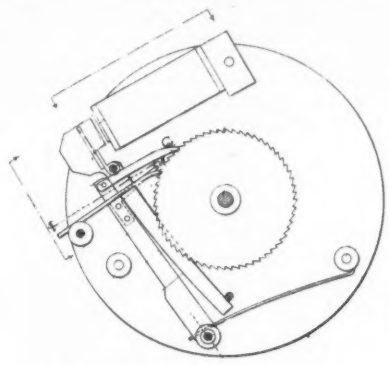
813,710. RELAY; Hemming Johansson, Stockholm, Sweden. App. filed July 21, 1904. An electro-magnet has its poles in proximity to a centrally pivoted lever of uniform polarity and moves the same for constant or pulsating current. The relay is, however, not responsive to alternating currents, which are too rapid to impart vibrations to the lever.

813,730. STORAGE BATTERY; Adolph Muller, Berlin, Germany. App. filed July 30, 1904. A battery plate support consisting of perforated covers provided with lateral loops and having pins inserted through the loops, the relation of the loops being such that the pins lock the covers together.

813,775. ELECTROMAGNETIC MOTOR; Murray Cheever, Boston, Mass. App. filed Feb. 20, 1905. A motor designed to secure a heavy torque at slow speed. A toothed wheel is intermittently stepped around by a pawl lever operated by an electromagnet.

813,840. INSULATED RAIL JOINT; McLeod W. Thomson, Altoona, Pa. App. filed Apr. 10, 1902. The fish plates have depending wings which converge toward one another beneath the base of the rail and serve to hold an insulating wooden block which serves as an insulating connection to strengthen the construction.

813,844. ELECTROLYTIC APPARATUS; Leroy Van Scoyoc, Gilbert Station, Iowa. App. filed May 15, 1905. An apparatus for decomposing water by electrolysis comprising a receiver, means including a valve



813,775.—Electromagnetic Motor.

actuated by variations in the water level in the receiver to supply water to the latter, a gas collector, electrodes in the receiver in suitable relationship to the gas collector and a valve actuated by variations in the water level in the receiver to control the discharge of gas to the collector.

813,879. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Charles D. Gilpin, Cleveland, O. App. filed Oct. 6, 1905. An arrangement for securing multiple control through two conductors. Currents are sent through the two conductors alternately which serves to move the various contactors successively.

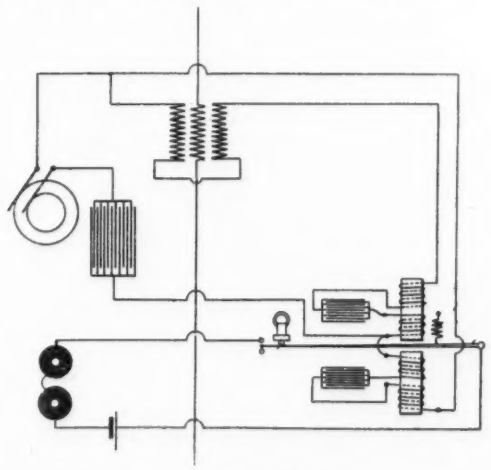
813,882. ELECTRIC SWITCH AND SIGNAL APPARATUS; Lawrence Griffith, Yonkers, N. Y. App. filed Nov. 5, 1904. A complete interlocking railway signal system so arranged that the various indicators cannot respond to a signal as long as electric energy is supplied to the signal "motion plates."

813,898. AUTOMATIC BLOCK SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; Gray W. Johnston and Alex. H. Ackermann, New York, N. Y. App. filed Apr. 25, 1905. Secures an overlap system by spaced contact plates along the road which successively receive energy from the power circuit. Avoids the use of local batteries or track potentials or other factors of variable or uncertain value.

813,900. AUTOMATIC ELECTRIC BLOCK SYSTEM; Albert M. Mott, Hampton, Iowa. App. filed June 26, 1905. Details of a circuit-closing device adjacent the track rails comprising a bow-spring which is depressed by the train and which steps around a ratchet wheel to alternately make and break a signal circuit by its successive motions.

813,914. WIRELESS ELECTRIC SIGNALING SYSTEM; Ragnar H. Rendahl, Berlin, Germany. App. filed Aug. 19, 1905. A capacity is bridged across the coherer or detector for the purpose of improving the resonance of the detector circuit with the antennæ circuit.

813,931. ANNUNCIATOR; James A. Wotton, Atlanta, Ga. App. filed May 16, 1904. Adapted for telephone switchboards and comprises an electromagnet with a sector-shaped armature which vibrates before the pole pieces on an axis parallel with the magnet cores.



813,975.—Wireless Telegraphy.

813,975. WIRELESS TELEGRAPHY; James F. King, Washington, D. C. App. filed Jan. 8, 1903. Patentee impresses local generator currents on two branch circuits, and then causes the currents in said circuits to set up opposing magnetic fields, one of which is normally stronger than the other. The received oscillations act to vary the normal relation between said fields.

813,996. MEANS FOR ELECTRICALLY CONNECTING RAILWAY RAILS AND THE LIKE; John M. Atkinson, Chicago, Ill. App. filed Mar. 15, 1904. The fish plates have a V-recess to closely engage the rail web and a soft copper strip is embedded in the walls of said recess to contact with the rail.

813,998. INSULATED RAIL JOINT; Bancroft G. Braine, New York, N. Y. App. filed Oct. 31, 1903. Details of a bolt fastening for insulated rail joints. The bolt has a split insulating jacket and insulating caps with annular recesses which receive the ends of said jacket.